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THE EXCHANGE OF ENERGY BETWEEN THE ATMOSPHERE AND THE OCEANS OF THE SOUTHERN HEMISPHERE

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THE EXCHANGE OF ENERGY BETWEEN THE ATMOSPHERE AND THE OCEANS OF THE SOUTHERN HEMISPHERE

SUMMARY

Seasonal and regional estimates have been made of the rate of evaporation from the oceans of the southern hemisphere, the exchange of sensible heat, the net radiation received, the total heat made available to the atmosphere by the condensation of water vapour and the flux of sensible heat from the sea surface, and the surplus energy available to the atmosphere in the latent form of water vapour.

INTRODUCTION

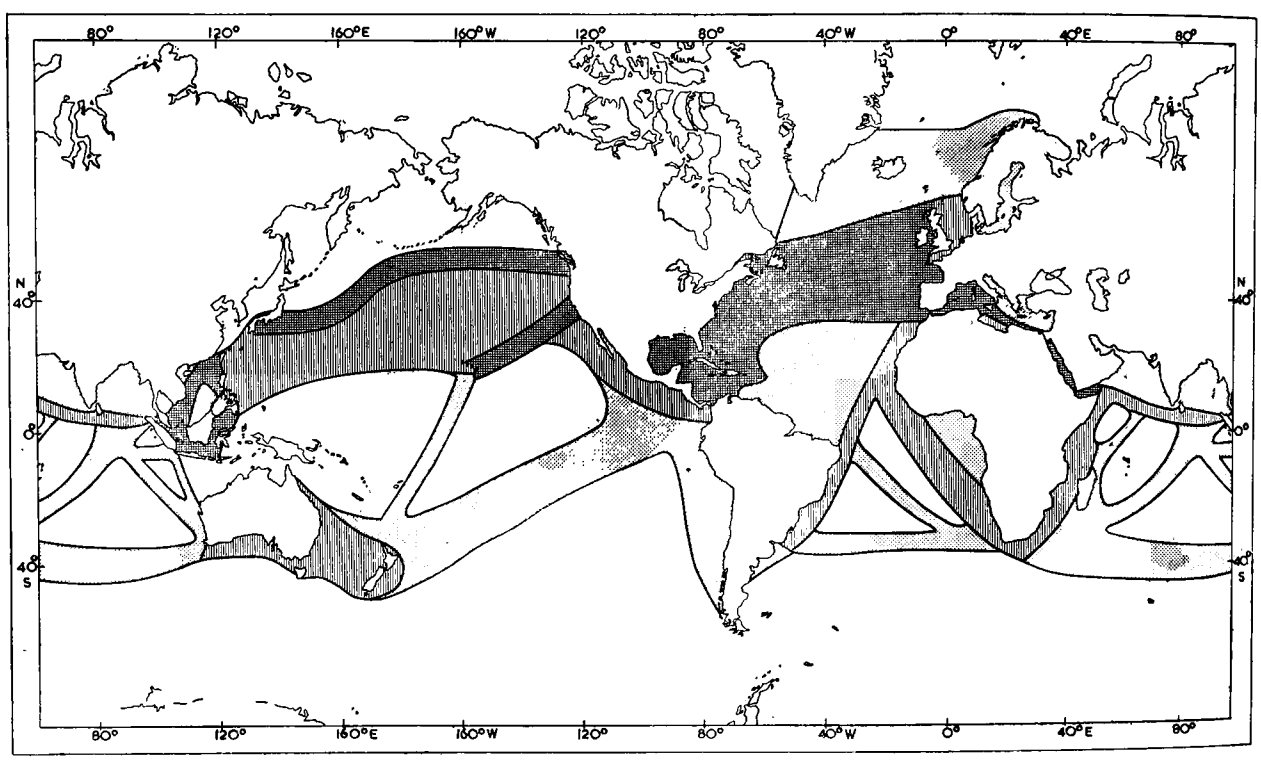
It is well known that the ocean can be regarded as a source of energy for atmospheric processes. The atmosphere is relatively transparent to short-wave solar radiation and a considerable amount is absorbed in the upper few metres of the sea. This energy gets back into the atmosphere as long-wave radiation, as a turbulent heat flux, or by evaporation; it is thought that this last process contributes through the realization of latent heat probably 40 per cent of the total heat gained by the atmosphere. By considering the latitudinal distribution of this secondary source and of the radiation sink one can construct a crude but lifelike picture of the general circulation of the atmosphere. To provide a more satisfying explanation of the general circulation, and of weather phenomena on smaller scales, the magnitude and distribution of heat transfer and evaporation must be more accurately known. Such knowledge is also required in connexion with the general circulation of the ocean, in particular with those currents which are density driven.

During recent years attempts have been made to portray the climatological distribution of some aspects of energy transfer, in particular evaporation, between sea and air. The most notable of these are the investigations of Albrecht[1]*, Jacobs[2, 3] and Budyko[4], who obtained respectively estimates for the months of February and August in the Indian and Pacific Oceans, seasonal values for the North Atlantic and North Pacific Oceans, and monthly values for the world's oceans. The present paper is concerned with the seasonal and regional variations of energy transfer from the oceans of the southern hemisphere, on which nothing had been published at the time the investigation was begun. A cursory inspection of the detailed results of these four investigations will show that they do not agree in detail; in fact, it is only in the broad outlines of the distributions and the establishment of the correct order of magnitude for the processes that there is general agreement. These discrepancies are probably due to the employment of different methods and data. For example, in each investigation the same basic formula was used to compute evaporation, but in each case with special modifications, for whereas Jacobs used only American data Budyko drew on a variety of sources, which differ in the times and methods of observation. A detailed comparison of the results of these investigations (for example, those for the southern hemisphere) and the methods by which they were obtained would be a large undertaking, and unlikely to add much to our understanding of the problem. For this reason this paper is restricted to an account of the methods used and the results obtained in this investigation, together with brief comments on the distribution.

* The index numbers refer to the bibliography on page 26.

§ 1—DATA

The meteorological data used in this investigation, with the exception of precipitation, were kindly supplied by the Marine Division of the Meteorological Office and consisted of surface observations recorded aboard British selected ships in the southern hemisphere during the period 1921–50; some indication of the distribution of these observations is shown in Figure 1. The instrumental observations used were of the dry-bulb and wet-bulb temperatures in a screen on board and of the sea surface temperature using a bucket; they were made with a standard set of instruments by approved methods. Wind speed and the amount of cloud cover were estimated. The observations, which were made every six hours, are thought to be of a relatively high quality. They are used in the preparation of the Meteorological Office atlases[5, 6, 7, 8]. The mean wind speed for each five-degree square was obtained from the data used in the preparation of the wind roses shown in the Meteorological Office atlases using conversion factors given by Privett[9]. Mean cloud amounts appropriate to the season and square were interpolated from the charts in these atlases.


80°
120°
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S
World Meteorological Organization
Sea areas in which the number of reporting ships is at present satisfactory.
Sea areas in which the number of reporting ships is quite inadequate, despite relatively frequent ocean traffic.
Sea areas in which the number of reporting ships is less satisfactory and in which further improvement is desirable and may be possible.
Sea areas which are relatively rarely traversed by ocean ships, and in which it is desirable to recruit as observing ships all available ocean-going vessels, even those undertaking only a single voyage in the area.

FIGURE 1—RELATIVE DENSITY OF REPORTING SHIPS OVER THE WORLD, COMPILED FROM INFORMATION SUPPLIED BY LLOYD'S AND THE GENERAL POST OFFICE

This map is based entirely on the normal geographical distribution of reporting ships, and takes no account of communication difficulties which may prevent reports from reaching collection centres.

The seasonal averages of precipitation for each ten-degree square were derived by Jacobs[3, 10], who combined Wüst's annual latitudinal values and Meinardus' annual areal distribution to obtain a consistent distribution of the total annual precipitation over the oceans; the total for each ten-degree square was then apportioned between the seasons on the basis of the average seasonal frequency at noon G.M.T. as shown in the United States Weather Bureau's *Atlas of climatological charts of the oceans*[11]. The reliability of these estimates is difficult to assess, but they are probably the best that can be obtained with the data available.

§ 2—METHODS OF COMPUTATION

Evaporation.—There are two main techniques of estimating energy transfer between the atmosphere and the ocean. One is to write an energy budget for a column of water extending from the surface to the bottom of the sea. Although simple in principle this is usually impossible in practice because there are insufficient data to determine the magnitude of some of the terms in the energy equation, notably those due to change in heat content and to the advective flux of heat into or out of the column. In the second method evaporation and turbulent heat transfer from the sea surface may be computed from equations based on the largely empirical results of research on atmospheric turbulence. This method is simple in practice, but is insecurely based in theory. It is assumed that the observations are made in the surface layer where the turbulent fluxes are independent of height, so that evaporation can be expressed by the empirical equation

$$E = k\rho(x_s - x_a)\, w\,, \qquad \ldots\ldots\ldots\ldots\ldots \quad (1)$$

where ρ is air density, x_s is the humidity mixing ratio corresponding to saturation with respect to sea-water at the sea surface temperature, x_a is the humidity mixing ratio and w is the wind speed at some standard height. In steady flow in nearly neutral hydrostatic stability over a uniform fixed surface k would be a constant, analogous to the drag coefficient, depending on the roughness of the surface. For the sea surface, k will vary with wind speed. It will also increase in unstable conditions, when the air is colder than the sea, and decrease in stable conditions. The best empirical method of estimating k at the present time is probably a combination of the ideas of Charnock and Ellison with those of Monin and Obukhov. Details can be found in the review by Sheppard[12], from which it appears that k increases by a factor of less than two as the wind increases from one to twenty metres per second. The effect of hydrostatic stability and instability is probably small over most of the ocean; k is unlikely to be increased by as much as 50 per cent even in the extreme instabilities found in the western parts of the northern hemisphere oceans. The present investigation was started before these comparatively recent ideas were well known and it was decided to take k as a constant and to determine it by the technique described by Jacobs[2, 3, 10]. Considering the quantity and quality of the data available the use of a variable k was not and is not justified.

Jacobs' method involves the use of both the energy budget and aerodynamic techniques. He calculated the energy budget by methods similar to those described later for four areas in the North Pacific and North Atlantic Oceans and, by assuming that the value of the advection term was negligible, Jacobs obtained a value for the mean annual evaporation from each area. These four values, together with the relevant climatic data, were inserted in equation (1) to give four values of k (see Table I). Jacobs considered that it was permissible to use the mean value of k in equation (1) to determine the daily rate of evaporation in each season from each five-degree square in the oceans of the northern hemisphere; he used climatic data supplied by the United States Weather Bureau.

Sverdrup[13] has suggested that Jacobs' value for k may only apply to the data used by him, which had been observed at noon G.M.T. With this comment in mind a new value for the factor was determined using British data, which had been taken at six-hourly intervals. The method

employed was similar to Jacobs' and the same four areas were used; the four values of k which were obtained are shown in Table I together with the values computed for three areas in the southern hemisphere. The energy balance method is sensitive to advection effects and the resulting values of k do not appear to differ significantly. The mean value of $k = 1{\cdot}8 \times 10^{-3}$ was therefore used in equation (1), which is written in the following form if E is in gm cm^{-2} day^{-1}, e, the vapour pressure, is in millibars and w is in knots:

$$E = 0{\cdot}00587\,(e_s - e_a)\,w \text{ gm cm}^{-2}\text{ day}^{-1}.$$

This equation was used with the marine meteorological data supplied by the Meteorological Office to compute the monthly rate of evaporation from each five-degree square of the oceans of the southern hemisphere.

TABLE I.—VALUES OF k COMPUTED FOR SELECTED AREAS USING DIFFERENT DATA

	British data	American data
	10^3k	
40°–45°N, 20°–50°W	1·3	1·7
20°–25°N, 25°–65°W	1·7	3·1
40°–45°N, 140°W–160°E	1·6	2·0
20°–25°N, 130°W–140°E	2·7	2·2
Mean value	1·8	2·3
20°–30°S, 150°–170°W	2·1	—
20°–30°S, 70°–90°E	1·2	—
20°–30°S, 10°–20°W	2·1	—
Mean value	1·8	—

The air density has been taken as $\rho = 1{\cdot}2 \times 10^{-3}$ gm cm^{-3} and the surface pressure as 1013 mb.

Exchange of sensible heat.—Values for the transfer of sensible heat were obtained on the assumption that the coefficients of eddy transfer for heat and water vapour are the same, a technique associated with the name of Bowen. The validity of the method is not established, but there seems little doubt that results obtained by using it will be approximately correct. The appropriate expression is:

$$Q_c = k\rho c_p\,(T_s - T_a)\,w\,,$$

in which the small correction involving the dry adiabatic lapse rate has been neglected.

The practical formula used is:

$$Q_c = 2{\cdot}29\,(T_s - T_a)\,w \text{ cal cm}^{-2}\text{ day}^{-1},$$

where Q_c is the sensible heat exchanged at the sea surface, and T_s and T_a are the temperatures in degrees Celsius of the sea surface and the air respectively.

Radiation.—For each five degrees of latitude seasonal values of the incoming short-wave solar radiation were prepared from the data tabulated by Kimball[14], which gives the daily totals of this radiation received on the 21st day of each month for certain latitudes. The decrease in these seasonal values due to cloud cover was accounted for by the use of Kimball's equation:

$$Q_t = Q_o\,(1 - 0{\cdot}71C)\,,$$

where Q_t is the average daily incoming short-wave radiation received at the sea surface in each five-degree square;

Q_o is the average daily incoming short-wave radiation received in the absence of clouds in each five-degree zone of latitude;

C is the fraction of sky covered by clouds in each five-degree square.

The values for Q_t were then reduced to allow for the amount which does not penetrate the sea surface because of reflection. The annual values given by Schmidt[15] were used for this correction; they range from 3·3 per cent at the equator to 5·3 per cent at 60°S.

The net long-wave radiation from the surface is the difference between the radiation emitted by the sea surface and the downward flux of long-wave radiation emitted by the atmosphere. Brunt[16] states that the relationship between the incoming and outgoing long-wave radiation may be expressed as:

$$R/\sigma A^4 = a + b\sqrt{e}\,,$$

where R is the total incoming long-wave radiation;
σA^4 is the black-body radiation at sea surface temperature A degrees Absolute;
a and b are constants whose values depend upon the moisture content;
e is the atmospheric vapour pressure in millibars.

Using mean values for a and b of 0·44 and 0·08 respectively, and taking the sea surface to be a black body, the net long-wave radiation, Q_b^1, before allowance for cloud cover is made is given by :

$$Q_b^1 = \sigma A^4 (0{\cdot}56 - 0{\cdot}08\sqrt{e})\,.$$

The emissivity suggested by Asklöff[17] and the modification for cloud cover suggested by Angstrom[18] were used in the following equation to compute the average daily net long-wave radiation (or back radiation), Q_b, from the sea surface:

$$Q_b = 0{\cdot}94\,[Q_b^1\,(1 - 0{\cdot}0083C)]\,.$$

Annual heat excess of (or the advective heat flux from) a column of water.—The heat budget of a column of water during a given time interval is represented by the equation:

$$Q_r = Q_a + Q_s + Q_v\,,$$

where Q_r is the net radiation received;
Q_a is the total energy lost from the sea surface by evaporation and the exchange of sensible heat;
Q_s is the amount of heat used for changing the temperature of the column of water;
Q_v is the advective flux of heat out of the column due to currents and mixing processes.

If the mean annual temperature of the water column does not change from year to year then the annual value of the storage term, Q_s, of the heat budget is zero. Thus the advective flux of heat out of the column (or the annual heat excess of the column) is the difference between the net radiation received, Q_r, and the total energy lost from the sea surface, Q_a.

Total heat gained by the atmosphere through the condensation of water vapour and the exchange of sensible heat.—The amount of heat gained by the atmosphere through the condensation of water vapour is given by:

$$Q_p = n^{-1} L_t P_s\,,$$

where Q_p is the amount of heat gained expressed in cal cm^{-2} day^{-1};
L_t is the latent heat of condensation ;
P_s is the seasonal precipitation rate expressed in cm per season;
n is the number of days in the season.

As the precipitation data were only available for each ten-degree square it was necessary to obtain mean values of the sensible heat exchanged for this size of square; the mean of the four five-degree squares was used. The total heat gained by the atmosphere is given by the equation:

$$Q_{pc} = Q_p + Q_c ,$$

where Q_{pc} is expressed in cal cm^{-2} day^{-1}.

Surplus energy available to the atmosphere in the latent form of water vapour.—The surplus is obtained by subtracting the value Q_p from that for Q_e for the ten-degree square. A positive value indicates that latent energy is locally surplus and available for transport to the continents and other parts of the ocean, where it is then made available as real heat through the process of condensation. A negative value indicates that an excess of latent energy is being transferred into real heat. The surplus energy also represents the difference between evaporation and precipitation because:

$$Q_e - Q_p = L_t (E - P) .$$

§ 3—Results

The results of this investigation are shown in Tables II–VIII (pp. 28–61). All the values are expressed in units of cal cm^{-2} day^{-1}, except those for evaporation, which are given in gm cm^{-2} day^{-1}; those numbers *in italics* are negative quantities. Each seasonal value is the mean of the three monthly values, except in the south-east Pacific and central south Atlantic oceans and to the south of 50°S where the data were very scanty; seasonal values were obtained for these areas by using seasonal mean values of temperature, etc. Values of the variables which involve the use of precipitation data are given for some squares in the south-east Pacific Ocean for which no values are shown for the other processes of energy transfer. These have been obtained by computing the seasonal and annual values for evaporation and the sensible heat exchanged for each ten-degree square from the few data available for these squares. These values, and the isopleths and profiles which have been constructed on the basis of them, should be treated with reserve.

§ 4—Discussion

Evaporation.—The areas of maximum evaporation in each ocean of the southern hemisphere are situated on the northern margins of the semi-permanent high pressure areas and in the south-west of each ocean at about latitudes 35–40°S (see Figure 2). The latter are associated with the southerly transport of warm water and the former correspond in extent with the trade-wind systems as defined by Crowe[19]; the area of absolute maximum evaporation corresponds closely with the area of highest mean wind speed. In the South Atlantic Ocean there is a third area of high evaporation situated about 35–40°S on the eastern side of the ocean which, despite the few observations upon which the values are based, is a persistent feature of the distribution throughout the year. Areas of low evaporation are found along the eastern and southern margins of each ocean and are associated with the distribution of cold water currents. The variation with latitude of the annual values for evaporation for each of the three oceans is shown in Figure 3. These profiles show that evaporation is highest in the Indian Ocean and, if the figures for the South Pacific Ocean are correct, least in the South Atlantic Ocean.

The variations with latitude of the seasonal values for each ocean are shown in Figure 3. These profiles show that evaporation is nearly everywhere greater in autumn and winter than in spring and summer. The values shown in Table II indicate that the absolute maximum occurs in autumn in the South Indian Ocean, that is, 0·97 gm cm^{-2} day^{-1} for the area 70–75°E, 20–25°S.

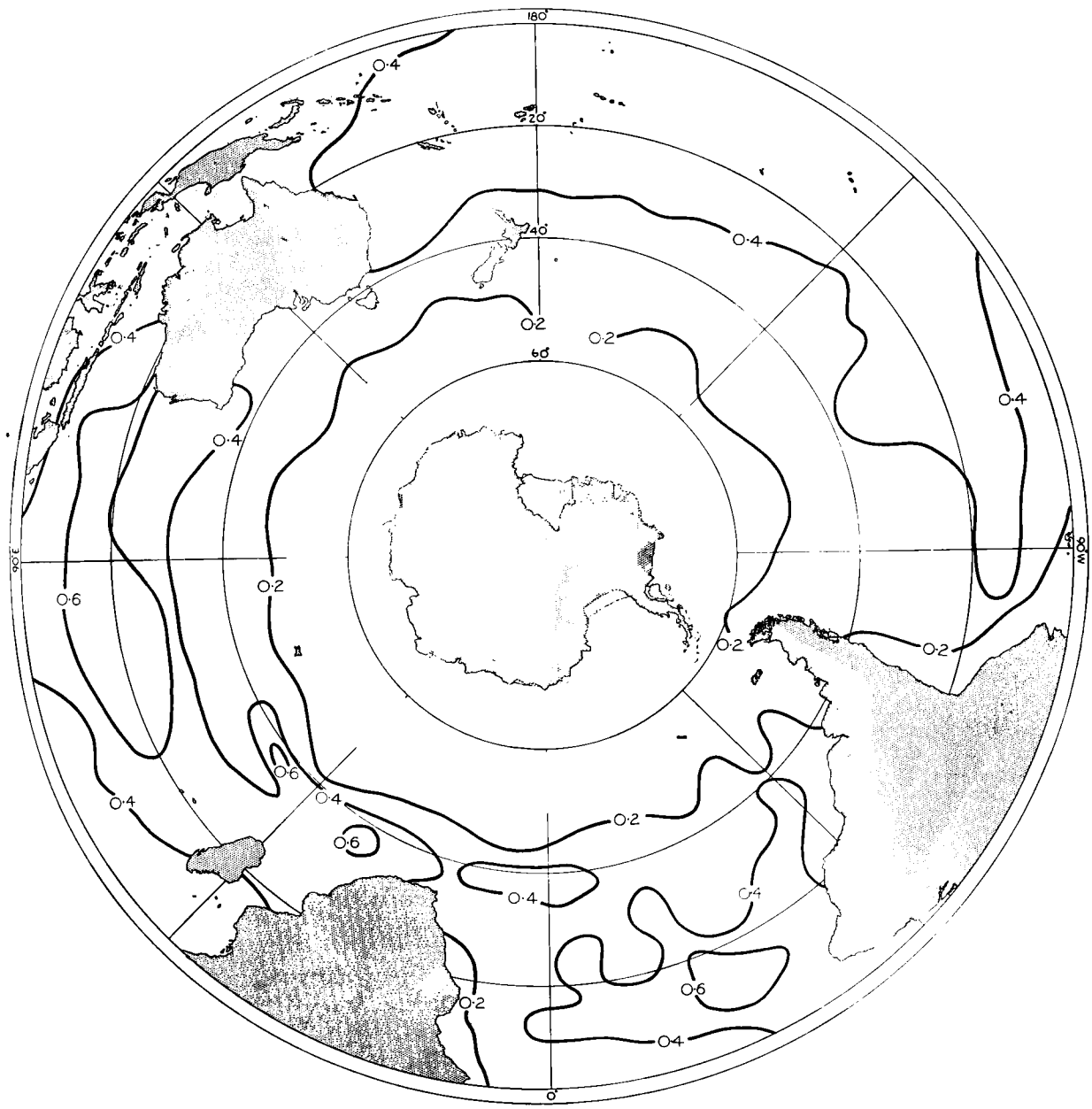

FIGURE 2—ANNUAL EVAPORATION

Unit: gm cm^{-2} day^{-1}

Note.—On this chart and subsequent circumpolar charts the lines of longitude are drawn only to the southernmost limit of observations.

Absolute minimum evaporation is negative, that is, condensation is taking place, and occurs in the South Atlantic Ocean in summer in the area 30–35°W, 50–55°S; " the rate of evaporation" is $-0{\cdot}04$ gm cm^{-2} day^{-1}. The seasonal curves also show that maximum evaporation occurs within the zones 10–25°S and 35–40°S in all seasons and as is shown in Figure 3, it is in these zones that the annual range is greatest. The variation with latitude of the total quantity of water evaporated per year for each five-degree latitude zone of ocean is shown in Figure 4. The profile for the southern hemisphere shows that a maximum is found in the zone 10–15°S with a secondary maximum in the zone 35–40°S.

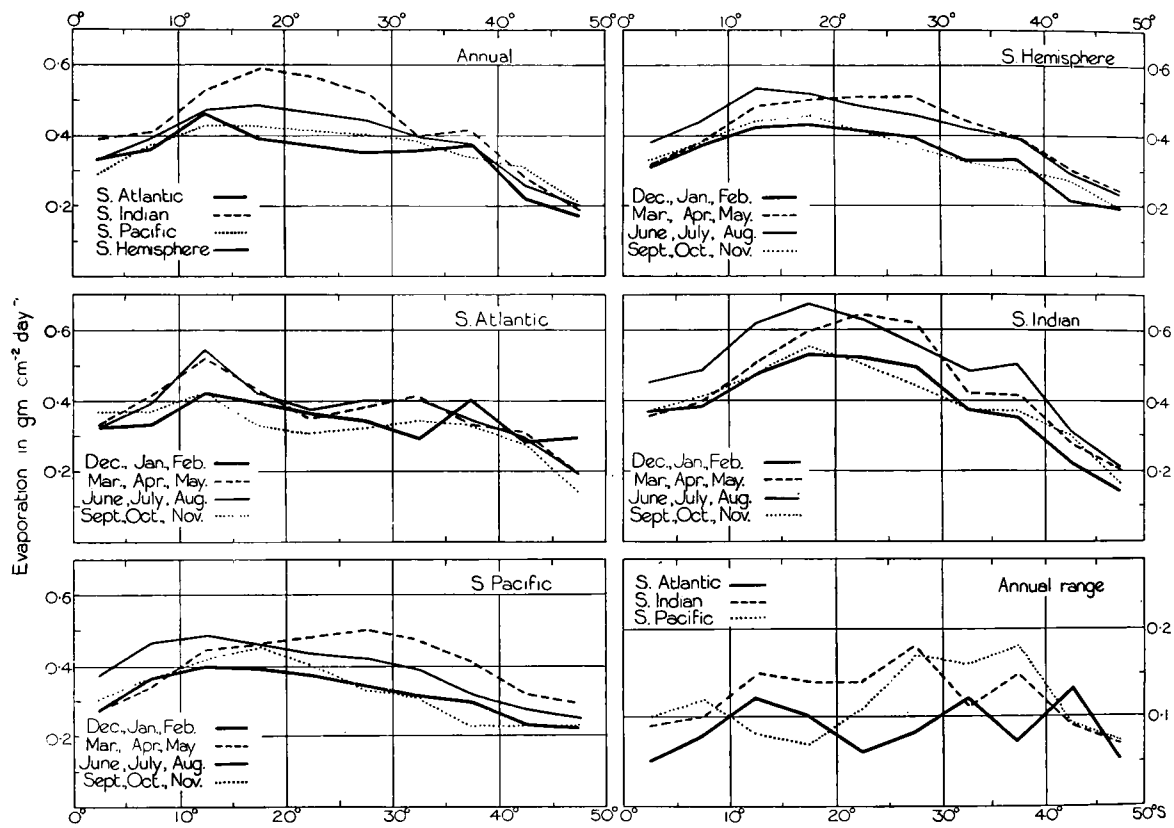

FIGURE 3—ANNUAL AND SEASONAL VALUES AND THE ANNUAL RANGE OF EVAPORATION ARRANGED ACCORDING TO LATITUDE

If the results of this investigation are comparable to Jacobs' for the northern hemisphere—and there is close agreement in the neighbourhood of the equator—then evaporation is higher in the southern hemisphere, particularly in the subtropical trade-wind belts. A comparison of the annual zonal values with those given by Wüst[20], shown in Figure 5, indicates that except in the equatorial region the methods used in this investigation lead to higher values over all the oceans, particularly between 10–25°S and 35–40°S. Wüst gives values which are equivalent to a mean evaporation of 114 cm per year between 0–50°S; the values given in this paper are equivalent to 139 cm per year.

Sensible heat exchanged at the sea surface.—The variation with latitude of the annual values of the sensible heat exchanged for each of the three oceans is shown in Figure 6. These profiles show that the amount of heat transferred is small near the equator, increases to a maximum value

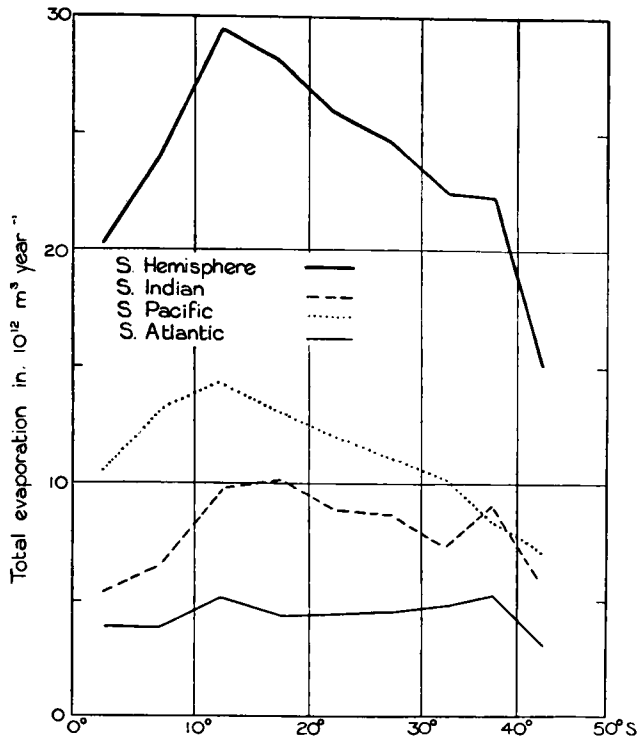

FIGURE 4—ANNUAL VALUES OF TOTAL EVAPORATION ARRANGED ACCORDING TO LATITUDE

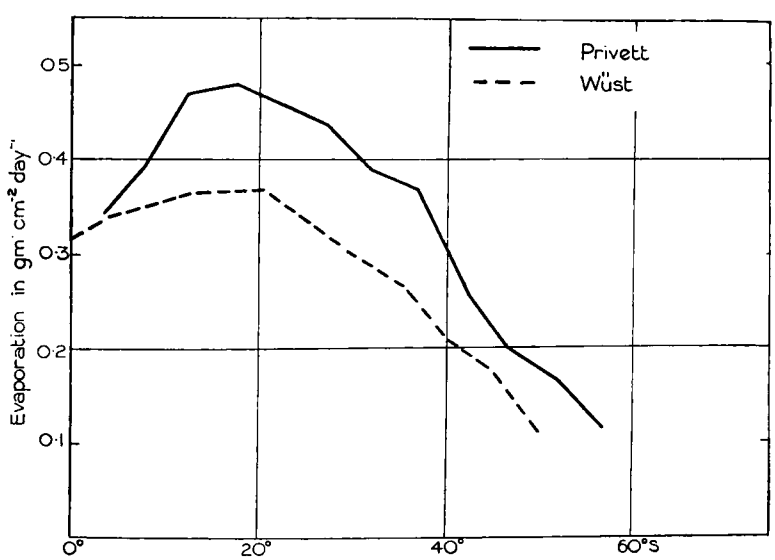

FIGURE 5—COMPARISON OF ANNUAL ZONAL VALUES OF EVAPORATION WITH THOSE GIVEN BY WÜST[20]

in all oceans between 35–40°S and then decreases; the distribution of the annual values in Figure 7 also shows these features. The annual chart shows that the maximum values found between 35–40°S are concentrated mainly on the western side of the ocean and that negative values, that is, the exchange is directed from air to sea, are found along the eastern margins of the oceans, in the equatorial region and in high latitudes. The variation with latitude of the seasonal values of the heat exchanged in the southern hemisphere as a whole are also shown in Figure 6.

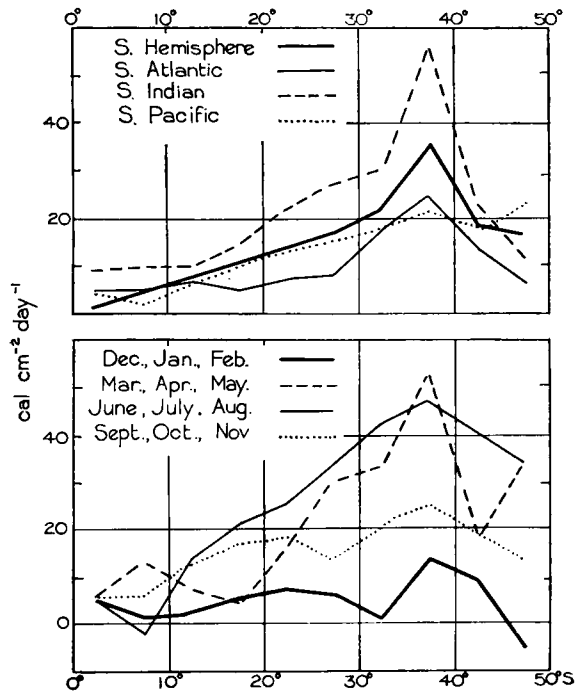

FIGURE 6—ANNUAL AND SEASONAL VALUES OF SENSIBLE HEAT EXCHANGED AT THE SEA SURFACE ARRANGED ACCORDING TO LATITUDE

These show that with the exception of the equatorial zone the exchange is nearly everywhere at a maximum in winter, at a minimum in summer, and it is higher in autumn than in spring. These profiles, however, mask certain features of the distribution of the positive and negative values. They show only two instances of a negative exchange, namely between 45–50°S in summer and 5–10°S in winter. An inspection of the values in Table III shows that in addition to these areas there are other regions where negative values are found, for example, in the central South Atlantic Ocean in spring.

Total energy exchanged at the surface.—The distribution of the values, shown in Figure 8, is very similar to that for evaporation. The maximum exchange occurs along the northern margins of the semi-permanent high pressure fields and there is a well defined secondary maximum in the south-west of each ocean. Due to the composite nature of these values, which include both the heat lost by evaporation and the sensible heat transferred, there is a sharper east to west gradient and better defined maximum between 35–40°S than in the evaporation chart. The annual range is greatest between 35–45°S.

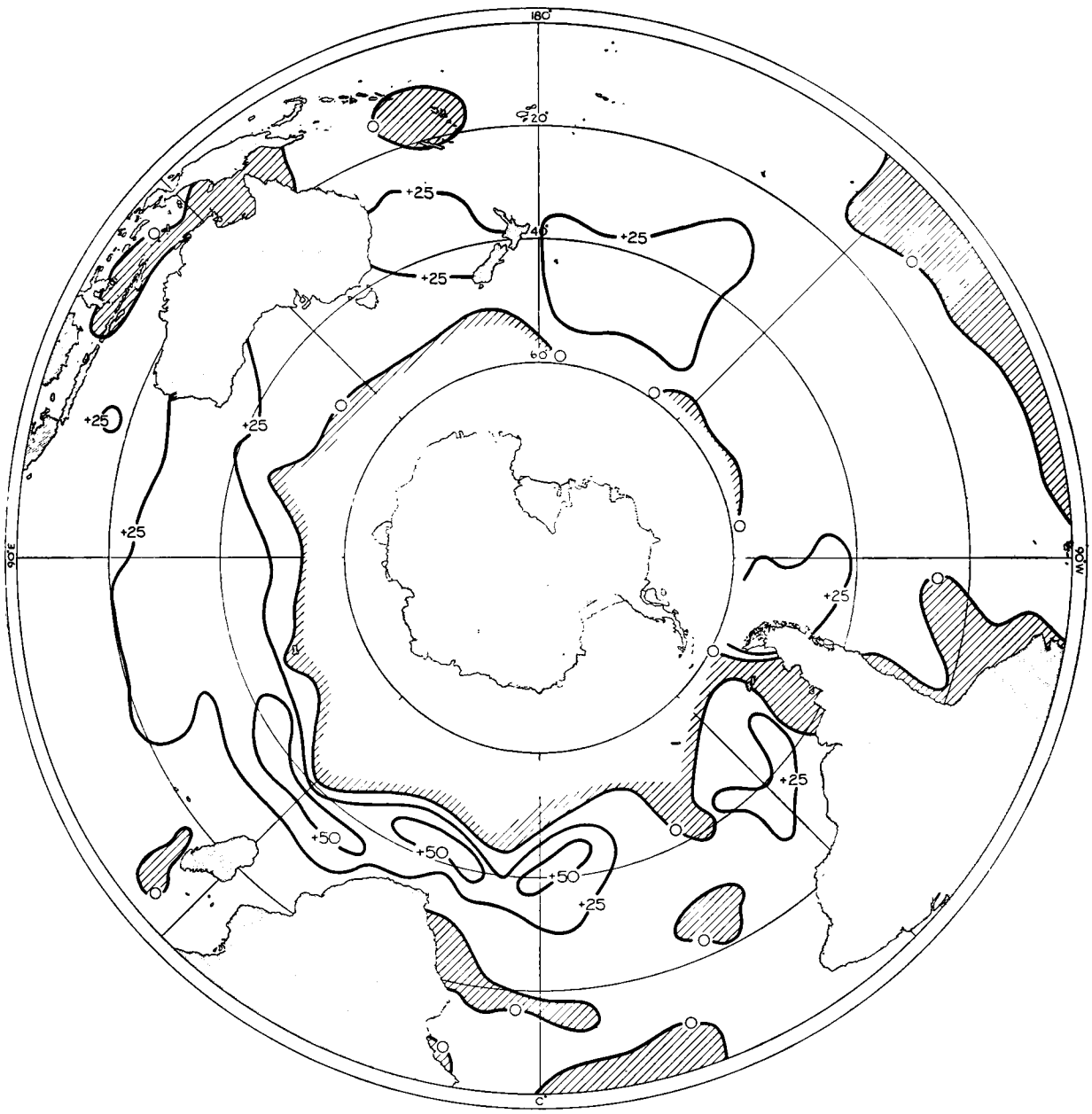

FIGURE 7—ANNUAL EXCHANGE OF SENSIBLE HEAT FROM SEA TO AIR

Unit: cal cm^{-2} day^{-1}

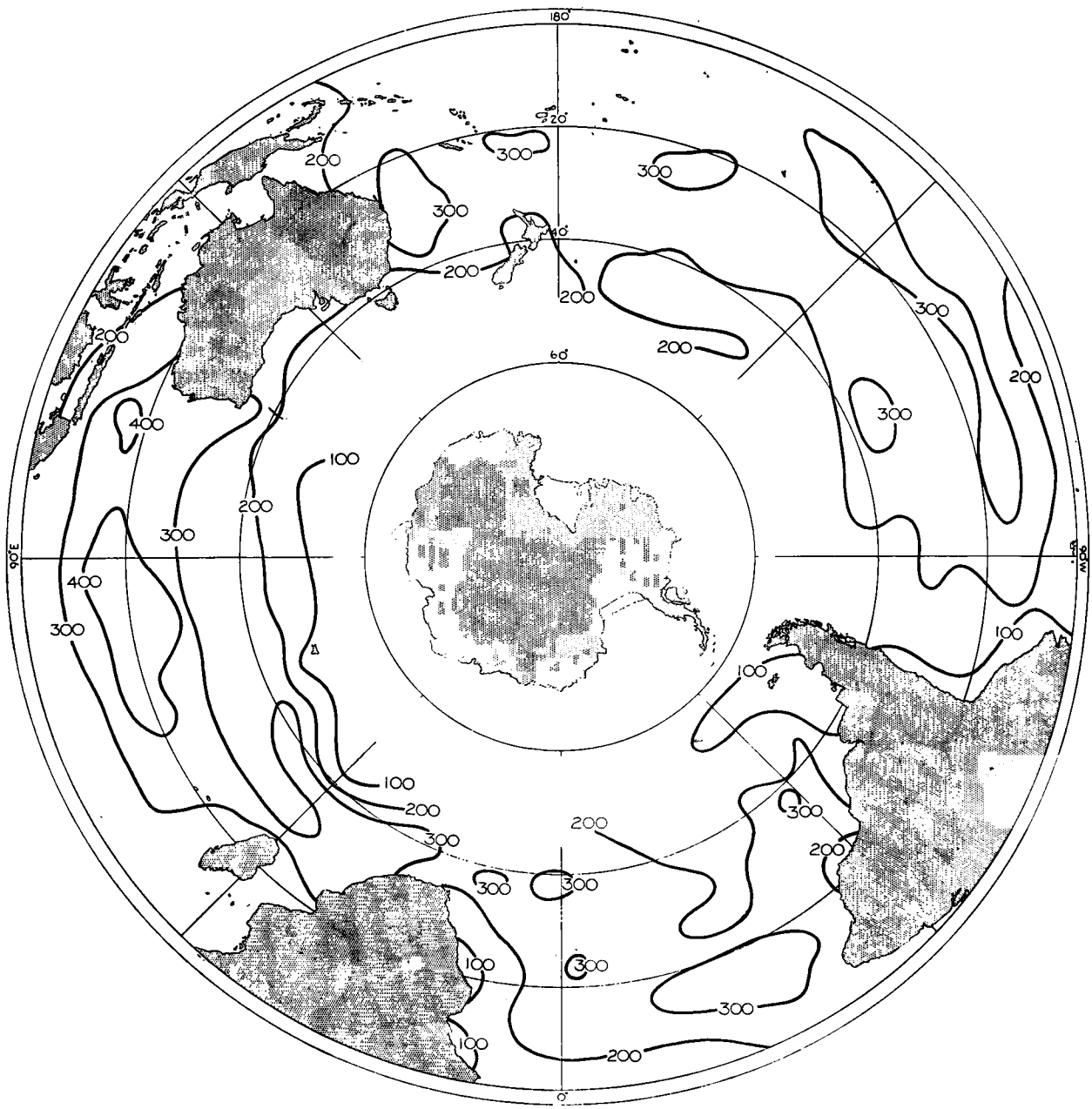

FIGURE 8—ANNUAL LOSS OF ENERGY BY EVAPORATION AND SENSIBLE HEAT

Unit: cal cm^{-2} day^{-1}

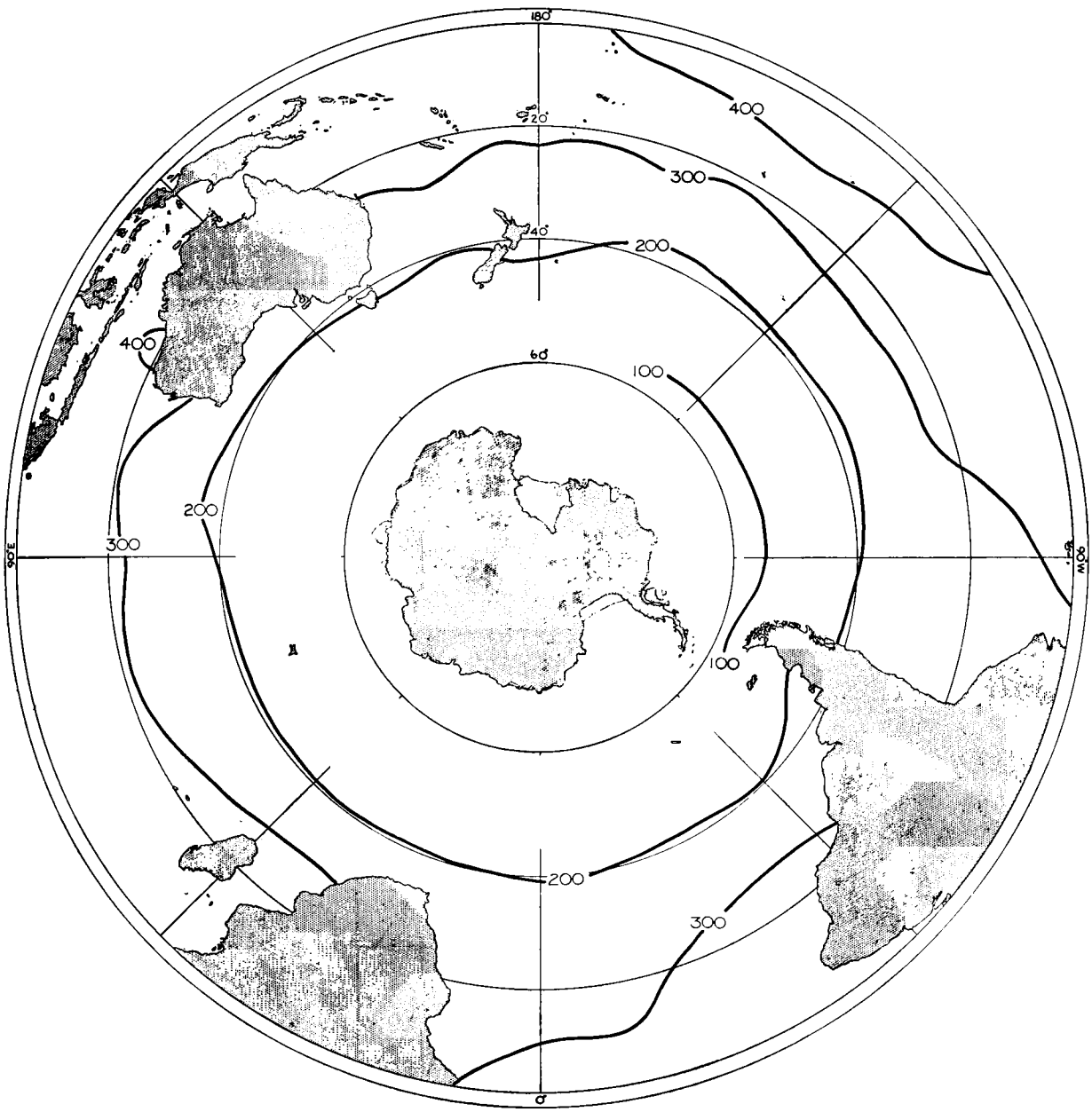

FIGURE 9—NET RADIATION RECEIVED
Unit: cal cm^{-2} day^{-1}

It is significant that the exchange is much higher in the trade-wind belts of the southern hemisphere than in the northern hemisphere, but over the warm ocean currents of middle latitudes it is more important in the northern hemisphere. The extensive land surfaces in the northern hemisphere are sources of cold, dry continental air in winter; this air mass is absent between the equator and 60°S. The presence of this air over the warm waters of the Gulf Stream and the Kuroshio current gives rise to large differences between the air and sea surface temperatures and there is therefore a high exchange of energy. Jacobs obtained values for the total energy exchanged of 937 and 728 cal cm^{-2} day^{-1} over the Gulf Stream and Kuroshio current respectively in winter. Over the corresponding currents in the southern hemisphere, that is, the Brazil, the Agulhas and East Australian currents, the maximum values obtained in winter were 446, 510 and 415 cal cm^{-2} day^{-1} respectively. Jacobs[2, 3] found in the northern hemisphere—" that all principal frontogenetic regions lie to the north-west of a zone of maximum energy exchange, and that their axes are parallel to the major axes of the zones of maximum energy exchange ". There is insufficient meteorological evidence to establish such a precise relation for the southern hemisphere, but it is of interest to note the correspondence in positions between the areas of maximum energy exchange between 35–40°S and the areas of cyclogenesis given by Vowinckel[21].

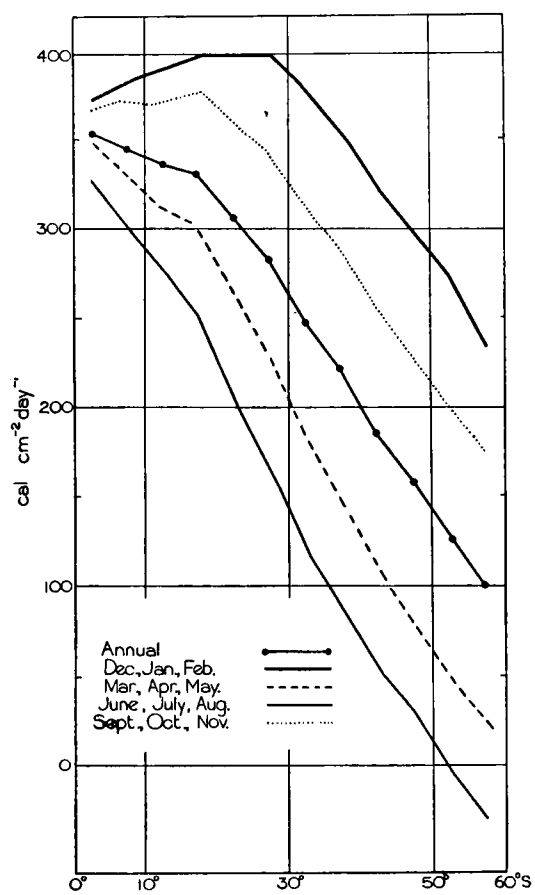

FIGURE 10—ANNUAL AND SEASONAL VALUES OF THE NET RADIATION RECEIVED ACCORDING TO LATITUDE

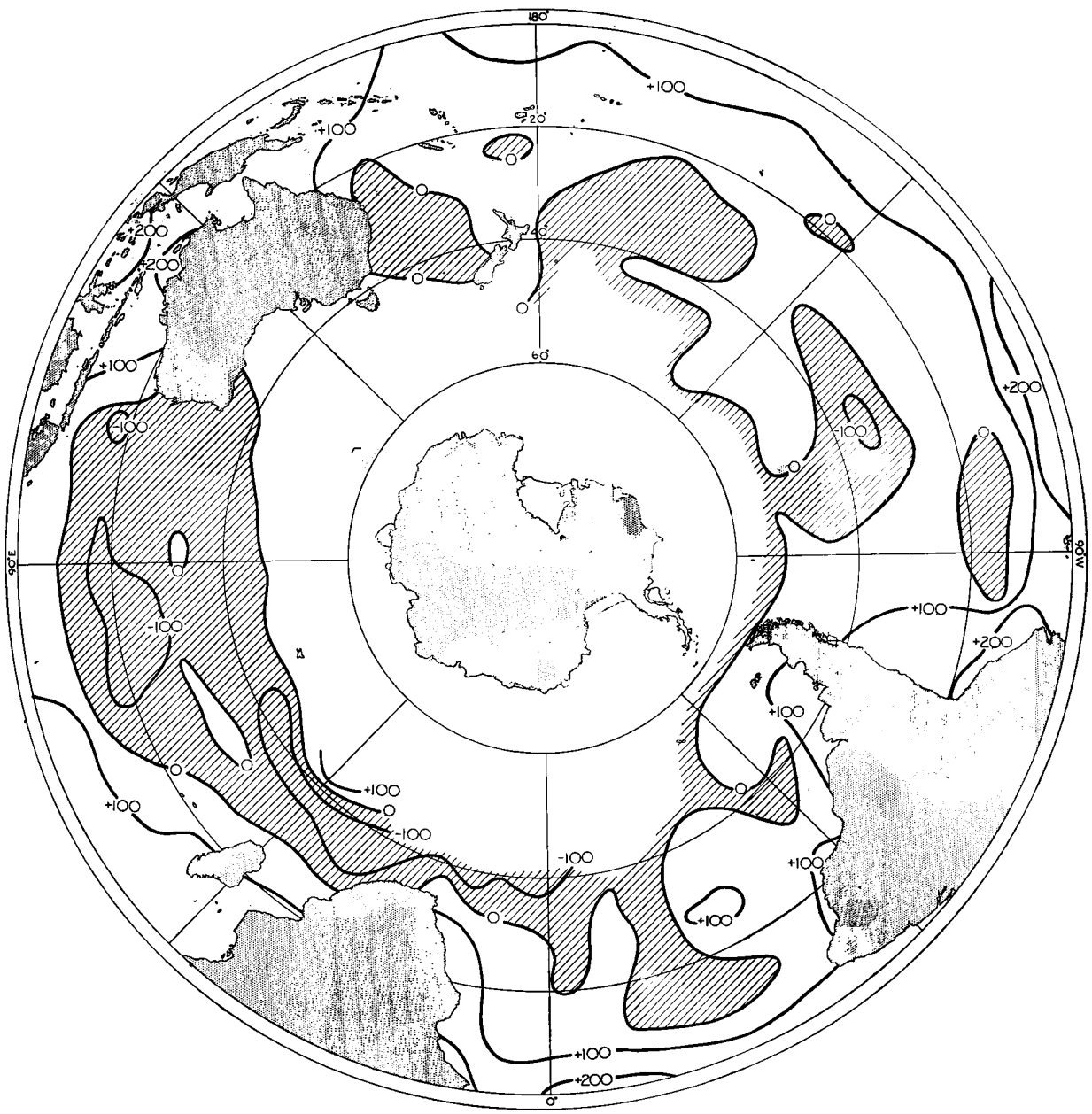

FIGURE 11—ANNUAL HEAT BALANCE
Unit: cal cm^{-2} day^{-1}

Net radiation received.—The distribution of the annual values of the net radiation received, which are shown in Figure 9, indicates that it is mainly a function of latitude. Deviations from the zonal distribution are due mainly to variations in the intensity of cloud cover. The variation with latitude of the annual and seasonal values is shown in Figure 10. These profiles show that the net radiation received is greatest in summer and least in winter and that it is greater in spring than in autumn over all the ocean except for the equatorial zone. In winter outgoing radiation exceeds incoming radiation to the south of 50°S. Unless there is a significant steepening of the annual profile to the south of 60°S it appears that over all the oceans of the southern hemisphere there is an annual surplus of radiation.

Annual heat excess.—The distribution of these annual values is shown in Figure 11. The chart shows that the excess is greatest in low latitudes; the absolute maximum value is found on the eastern margin of the South Pacific Ocean near the equator. Between 15–45°S the areas of surplus heat alternate with areas showing a deficit of heat. Nearly everywhere these negative areas are situated in the centre of the oceans and are flanked by positive areas, for example, the South Atlantic Ocean. To the south of 45°S the distribution is vague because of the lack of data. In the South Pacific and South Atlantic Oceans there appears to be a zone of negative values, but between 30–180°E there are indications of an area of surplus heat. In general it appears that in low and middle latitudes the oceans are heated on their flanks and cooled in the centre;

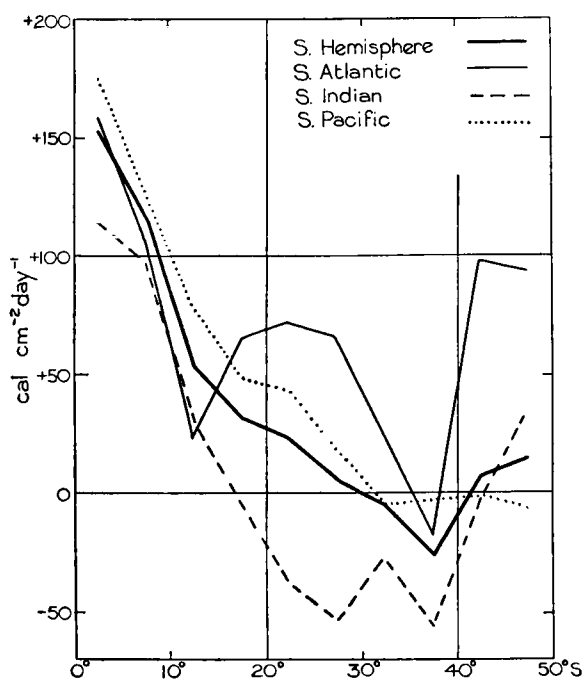

FIGURE 12—ANNUAL VALUES OF THE HEAT BALANCE ARRANGED ACCORDING TO LATITUDE

the latter areas correspond to the areas of maximum evaporation in each ocean. The variation with latitude of these values in each ocean, which is shown in Figure 12, indicates that the heat excess is greatest in low latitudes, is at a minimum between 35–40°S and has a tendency to increase further to the south. This last feature, however, should be treated with reserve as it is based upon insufficient evidence.

The total heat acquired each day in each five-degree zone is arranged by latitude in Figure 13. The mean zonal values for 40–50°S have not been included in this diagram because of the small amount of data available. Assuming that the heat content of the oceans remains constant from year to year the surplus of heat acquired by the oceans between the equator and 40°S must be transported out of this area and used to make good a deficit in the annual heat budget elsewhere. An estimate has been made of the mean deficit in the annual heat budget which would be required between 40–70°S to balance the surplus in the northern parts of the oceans. By subtracting from the total surplus gained between the equator and 40°S in the South Atlantic Ocean the amount of heat carried northward across the equator in this ocean (Jung[22]), adding to the surplus of heat

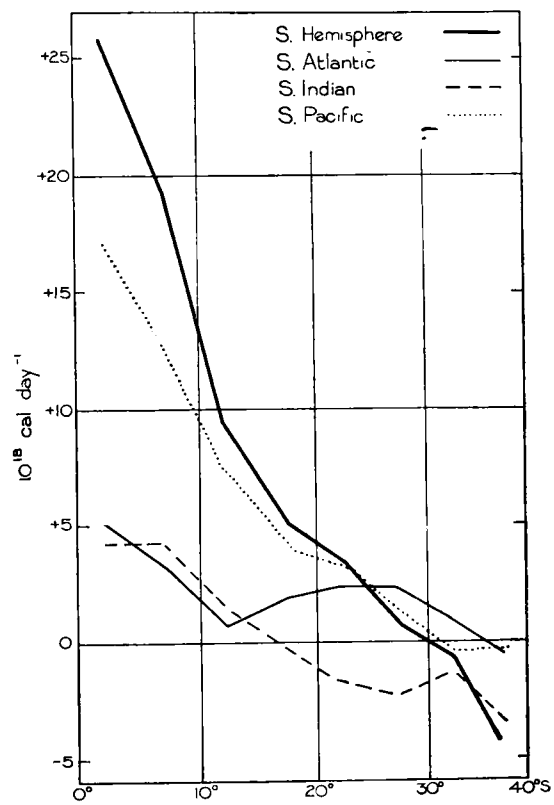

FIGURE 13—TOTAL HEAT ACQUIRED IN EACH ZONE ARRANGED ACCORDING TO LATITUDE

acquired by the South Indian Ocean between the same latitudes the surplus acquired by the North Indian Ocean, and assuming no transport across the equator in the Pacific Ocean, it is calculated that the net transport southward across 40°S would amount to 6992×10^{16} cal per day. This surplus would be dissipated if the mean deficit in the annual heat budget in the zone 40–70°S was approximately 92 cal cm^{-2} day^{-1}.

Total energy gained by the atmosphere through the condensation of water vapour and the exchange of sensible heat.—The distribution of the annual values is shown in Figure 14. The values are nearly everywhere highest in the equatorial zone and to the south of 45°S and are lowest along the eastern margins of the oceans in tropical latitudes; a value of −1 cal cm^{-2} day^{-1} was obtained in the eastern South Atlantic Ocean. The values in the subtropical latitudes increase westward across each ocean and an absolute maximum value is found in the eastern equatorial

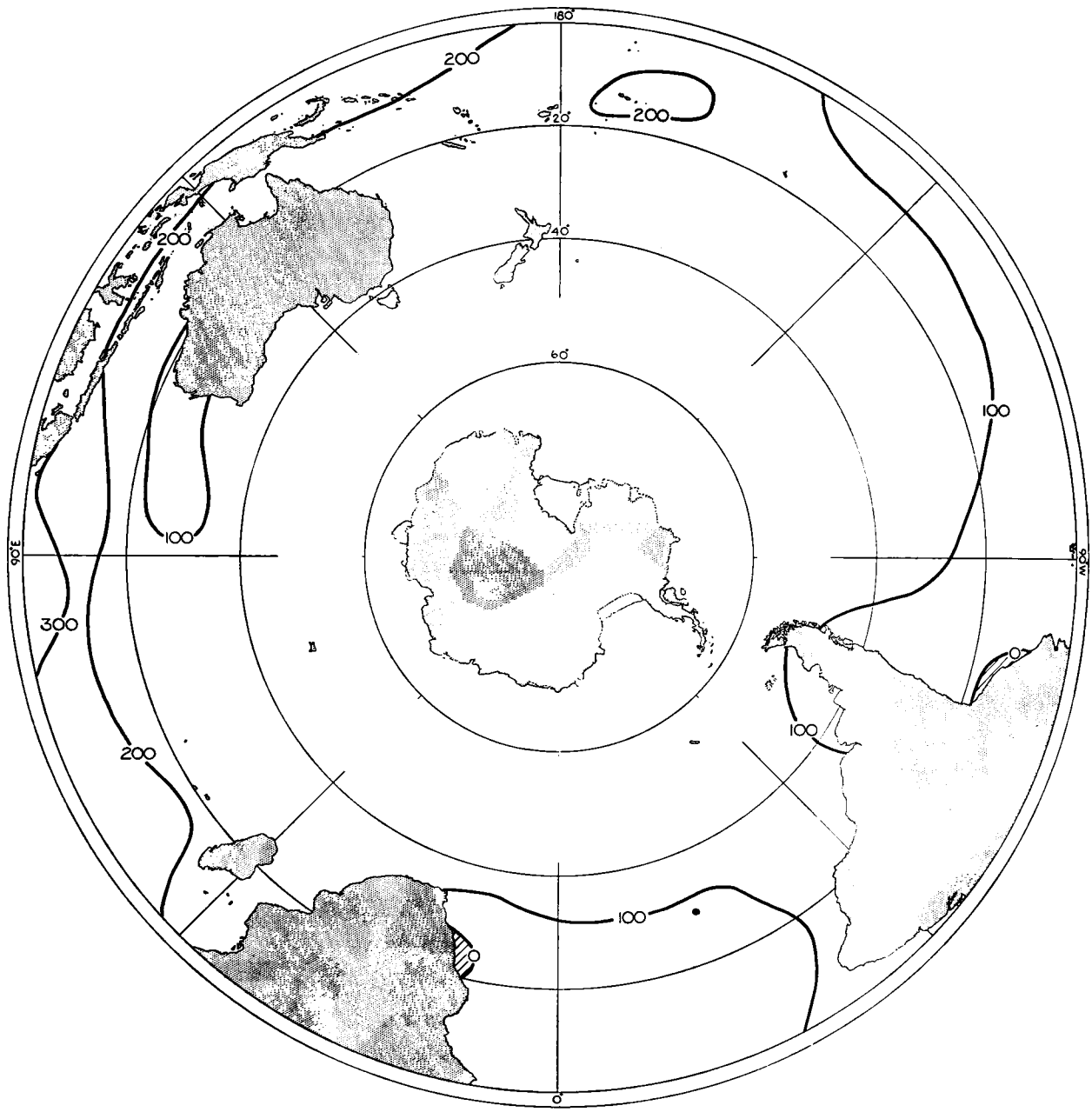

FIGURE 14—TOTAL ENERGY GAINED BY THE ATMOSPHERE THROUGH EXCHANGE OF SENSIBLE HEAT AT THE SEA SURFACE AND CONDENSATION OF WATER VAPOUR

Unit: cal cm^{-2} day^{-1}

region of the South Indian Ocean. The variations with latitude of the annual values for each ocean and for the southern hemisphere are shown in Figure 15. The " Pacific " profile is an exception to the main pattern, for instead of a minimum in subtropical latitudes there is a maximum. Over much of this ocean the distribution is similar to that in other oceans, but in the neighbourhood of the islands of the central South Pacific Ocean there is an area of high values for precipitation, which have an important effect on these zonal values. It is, of course, possible that the high rainfall near the islands is not typical of the ocean surrounding them.

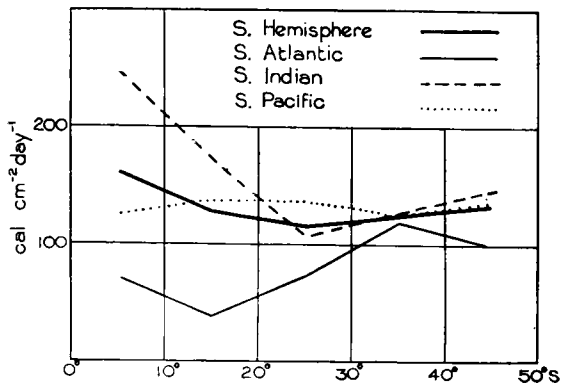

FIGURE 15—ANNUAL VALUES OF TOTAL ENERGY GAINED BY THE ATMOSPHERE THROUGH EXCHANGE OF SENSIBLE HEAT AT THE SEA SURFACE AND CONDENSATION OF WATER VAPOUR ARRANGED ACCORDING TO LATITUDE

Surplus of energy available to the atmosphere in the latent form of water vapour.—The distribution of annual values, which is shown in Figure 16, shows there is an area of high values in the subtropical region of all three oceans, which is flanked by low values, and a secondary maximum on the western side of each ocean about 45°S. Negative values, which represent an excess of precipitation over evaporation, are found to the south of 50°S and in the equatorial zone between 50–160°E. The variation with latitude of the annual and seasonal values for each of the oceans is shown in Figure 17. The seasonal variation can be compared with that obtained by Jacobs for the northern hemisphere, where there is a maximum in winter and a minimum in summer. The variation is similar between the equator and 20°S but between 20–40°S the maximum values occur in autumn. The few results which are available for the zone 50–60°S show that in all seasons precipitation exceeds evaporation. In the equatorial zone the only significant negative value occurs in the Indian Ocean during summer. This appears reasonable when it is considered that the equatorial trough has a mean annual position of 5°N and its only major incursion into the southern hemisphere is over the Indian Ocean in summer, that is, December, January and February.

The total annual surplus of latent energy for each zone is shown in Figure 18. A deficit occurs only between the equator and 10°S in the Indian Ocean and to the south of 50°S. The largest surplus is found between 10–20° S in the South Atlantic Ocean and South Pacific Ocean and between 20–30°S in the Indian Ocean; the absolute maximum for the southern hemisphere occurs between 20–30°S. Both the annual chart and the seasonal profiles show that the oceans between 10–45°S are a source region for moisture which is transported to other parts of the world.

Using the values computed in this investigation, those given by Jacobs[10] for the North Atlantic and North Pacific Oceans and some figures given by Reichel[23] for evaporation and precipitation over land, estimates have been made of the net transport of water vapour across latitude circles required for a balance between evaporation and precipitation for the earth. The

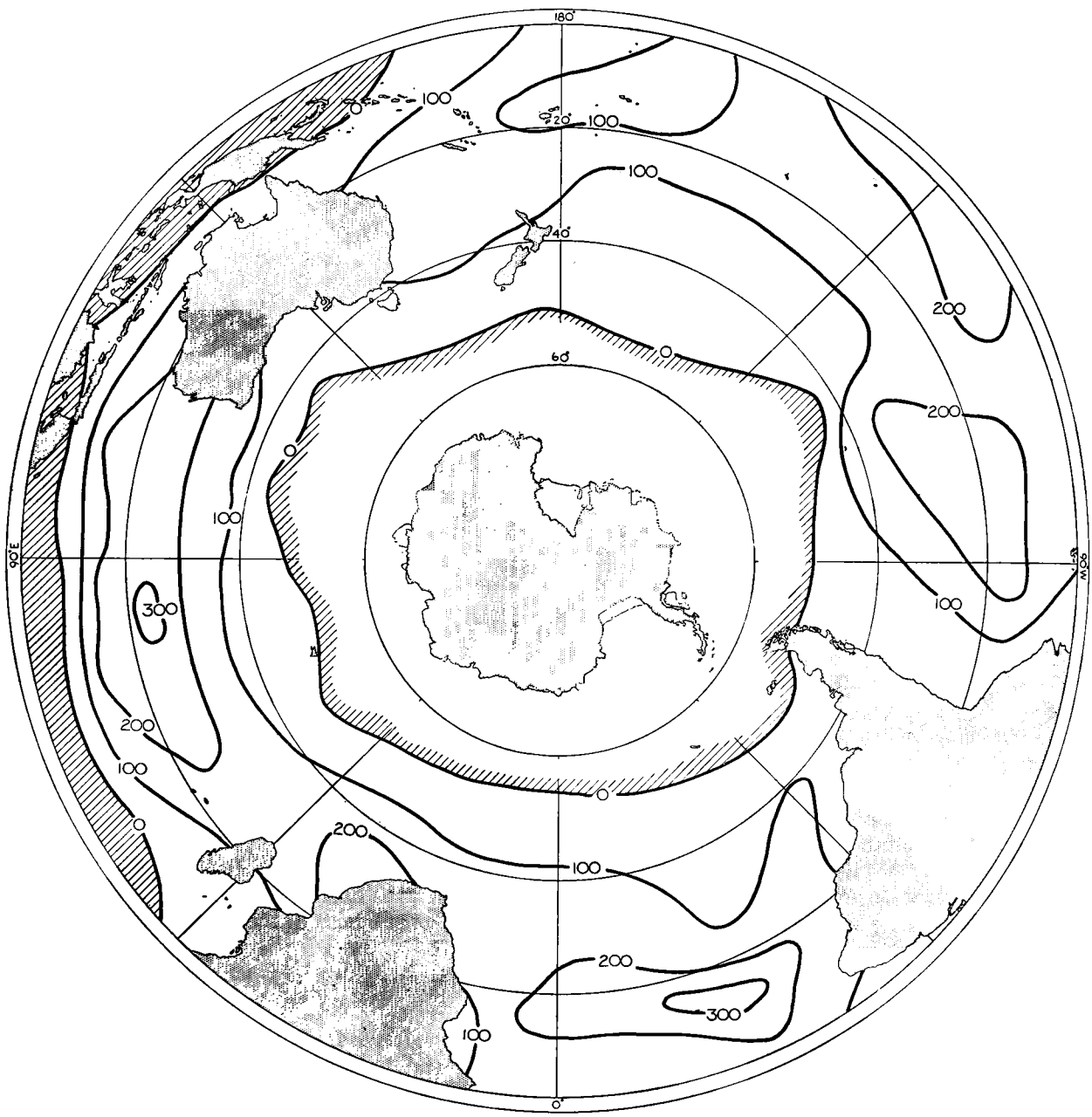

FIGURE 16—SURPLUS OF ENERGY AVAILABLE TO THE ATMOSPHERE IN THE LATENT FORM OF WATER VAPOUR

Unit: cal cm^{-2} day^{-1}

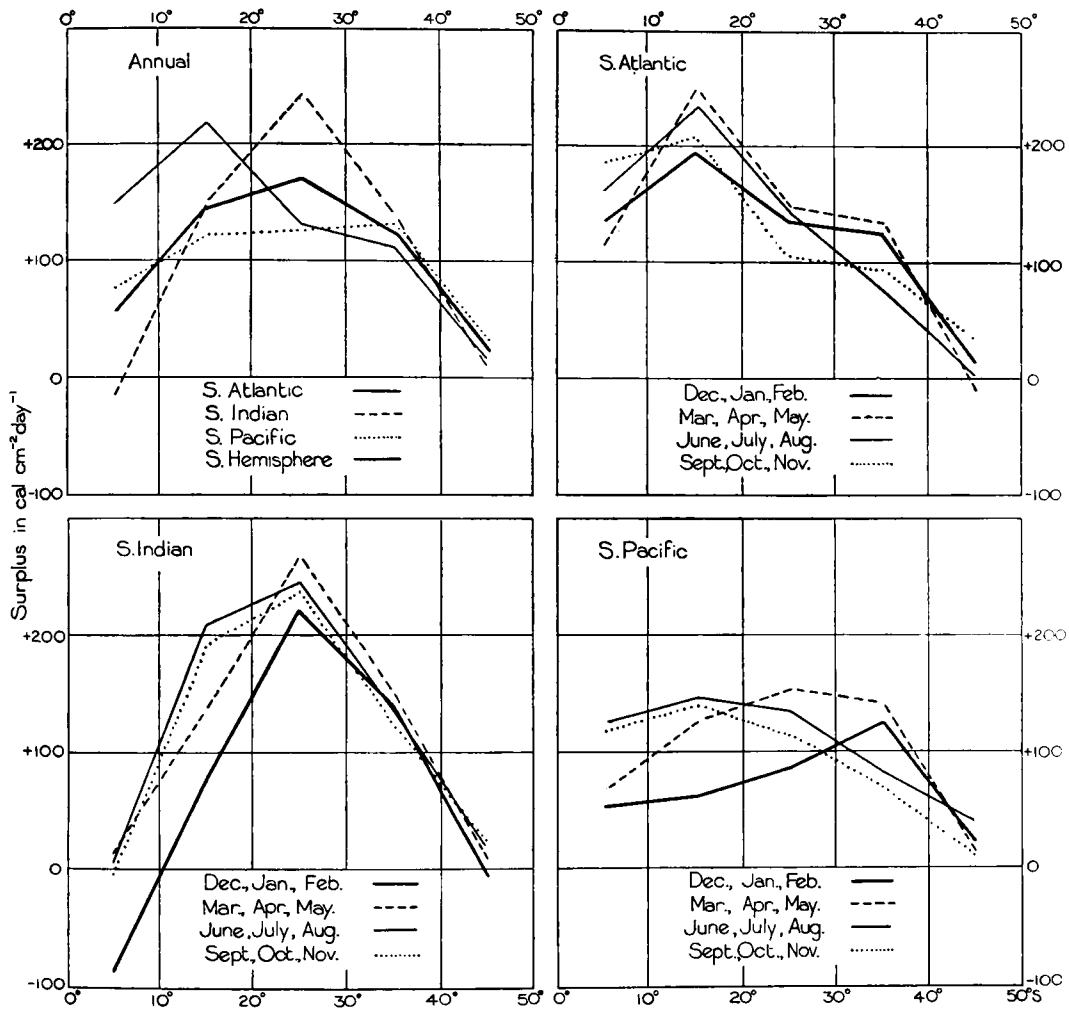

FIGURE 17—ANNUAL AND SEASONAL VALUES OF THE SURPLUS OF ENERGY AVAILABLE TO THE ATMOSPHERE IN THE LATENT FORM OF WATER VAPOUR ARRANGED ACCORDING TO LATITUDE

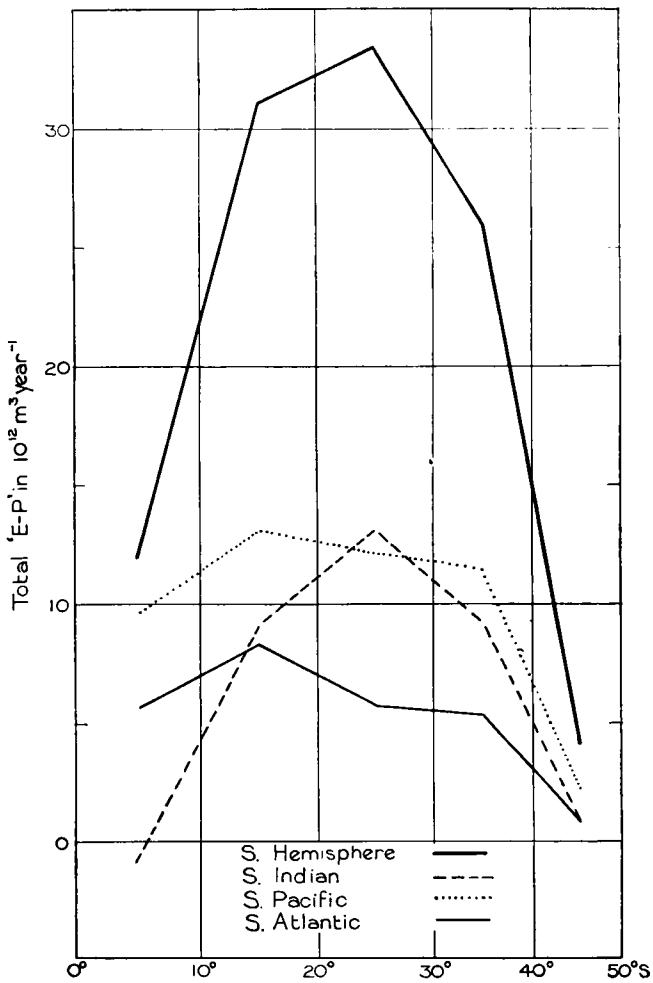

FIGURE 18—ANNUAL VALUES OF TOTAL '*E* – *P*' ARRANGED ACCORDING TO LATITUDE

results are shown in the diagram, Figure 19. The full line shows the total surplus or deficit of water vapour over each ten-degree zone of the oceans. As computed values for "$E - P$" are only available between 60°N and 60°S an estimate has been made for the remaining ten-degree zones of the earth's surface by assuming evaporation for the whole world must equal total precipitation. The resulting figure for the total "$E - P$" in these high latitudes has been allocated to the ten-degree zones in the same ratio as the relative proportion of sea in each zone. The main features of the resulting profile are the maximum surplus in the tropical trade-wind

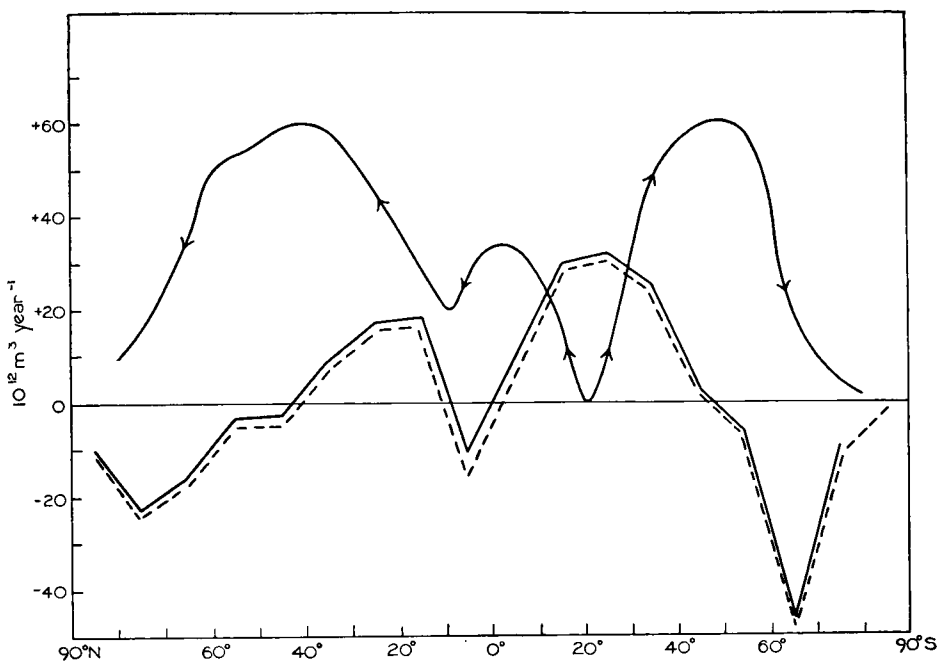

FIGURE 19—NET TRANSPORT OF WATER VAPOUR ACROSS LATITUDE CIRCLES REQUIRED FOR A BALANCE BETWEEN EVAPORATION AND PRECIPITATION FOR THE EARTH

——— '$E - P$' for each 10-degree zone of oceans.
- - - - - Total surplus or deficit of water vapour in each 10-degree zone of world.
——→ Net transport of water vapour across latitude circles required for balance.

belts, the deficit at 5°N which agrees with the position of the equatorial trough, and the large deficits found in high latitudes. The pecked line shows the total surplus or deficiency in each ten-degree zone of the whole world. The value for each zone was obtained by adding the total "$E - P$" value for the oceans to that for the land. Reichel's figures show that precipitation always exceeds evaporation over land, so that the pecked line is always just below the full line in the diagram. The curve, which shows the net transport of water vapour across latitude circles required for a balance, indicates that a large quantity of water vapour is transported across the equator northwards from 20°S, and that maximum transport takes place at 40°N and 50°S in the respective hemispheres.

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TABLES OF
ENERGY EXCHANGE

TABLE II—MEAN EVAPORATION

Annual

	0°					30° E						60°E						90°E
							centimetres per day											
0°																		
	·30	·22							·35	·36	·35	·34	·38	·38	·38	·42	·43	·43
	·36	·28	·11						·36	·38	·34	·34	·40	·38	·39	·46	·48	·49
	·41	—	·20						·35	·36	·43	·52	·49	·50	·61	·65	·66	·69
	·38	·30	·15					·43	·37		·42	·50	·58	·70	·77	·77	·71	·71
20°S																		
	·34	·30	·16					·48	·44	·45	·48	·49	·58	·64	·63	·69	·78	·68
	·33	·33	·24				·50	·50	·48	·51	·50	·47	·51	·54	·57	·62	·64	·57
	—	·38	·34	·30		·42	·58	·52	·42	·39	·36	·35	·32	·32	·38	·35	·38	·36
	·47	·42	·49	·38	·50	·54	·62	·58	·56	·56	·61	·54	·41	·36	·36	·38	·35	·32
40°S																		
	—	—	—	—	—	—	·34	·23	·14	·15	·22	·38	·42	·34	·36	·34	·30	·31
	—	—	—	—	—	—	—	—	—	—	—	·16	·20	·12	·17	·18	·19	·23
	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
60°S																		

	180°W					150°W						120°W						90°W
							centimetres per day											
0°																		
	—	·46	·42	—	—	—	—	·44	—	—	—	—	·32	·26	·22	·20	·22	·21
	—	·47	—	—	—	—	·50	·52	—	·51	·49	·48	—	·46	·40	·42	·39	—
	·43	·42	·47	—	·44	·46	·48	·54	·52	—	—	·58	·54	·51	·53	·54	—	—
	·46	·41	—	—	—	·46	·44	—	·59	·58	·51	·46	·42	·44	·50	·52	—	—
20°S																		
	·42	·42	·41	·48	—	·46	·43	·47	·44	·40	·43	·43	·47	·42	·42	—	—	—
	·44	·43	·45	·47	—	·44	·45	—	—	—	·40	·38	·49	—	—	—	—	—
	·39	·41	·38	·41	—	·37	—	—	·36	·38	·31	·35	—	—	—	—	—	—
	·38	·35	·33	·34	·31	·33	—	—	·30	—	—	—	—	—	—	—	—	—
40°S																		
	·31	·31	·26	·26	·26	·24	—	—	—	—	—	—	—	—	—	—	—	—
	—	·29	·26	·26	·28	·27	·28	—	—	—	—	—	—	—	—	—	—	—
	—	—	—	—	—	—	—	·16	·18	·17	·23	·21	·20	·18	·21	·19	·17	·21
	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
60°S																		

December, January and February

	0°					30°E						60°E						90°E
							centimetres per day											
0°																		
	·31	·24							·34	·32	·30	·30	·37	·38	·38	·40	·40	·41
	·31	·27	·10						·36	·35	·34	·30	·38	·35	·38	·42	·40	·39
	·39	·26	·23						·32	·30	·38	·43	·39	·46	·48	·57	·57	·62
	·37	·31	·14					·44	·33		·36	·45	·46	·72	·62	·64	·65	·70
20°S																		
	·36	·37	·18					·46	·51	·45	·42	·44	·54	·67	·51	·53	·59	·60
	·26	·34	·31				·49	·47	·48	·52	·51	·52	·40	·54	·47	·52	·52	·58
	·30	·38	·41	·30		·41	·61	·57	·40	·35	·30	·28	·27	·30	·30	·33	·37	·34
	·65	·54	·51	·39	·44	·49	·58	·52	·45	·41	·34	·26	·28	·26	·38	·30	·34	·32
40°S																		
	·30	·11	—	—	—	—	·38	·30	·07	·13	·14	·29	·32	·29	·23	·19	·18	·19
	·31	·53	—	—	—	—	—	—	—	—	·02	·12	·09	·05	·07	·06	·08	·16
	—	—	—	—	—	—	—	—	—	—	·16	·22	—	—	—	—	—	—
	·00	—	—	—	·05	·06	—	·03	·04	·05	—	—	—	—	—	—	·06	·02
60°S																		

FROM SEA SURFACE

Annual

centimetres per day

	90°E					120°E						150°E						180°E
0°	·43	·39	—	·30	·39	·33	—	·22	·25	—	·29	26	·30	—	—	—	—	—
	·44	·45	·48	·48	·42	·34	·31	·33	·31	·32	—	·24	·30	—	·46	·46	—	—
	·64	·58	·62	·65	·46	·42	·35	·31	·29	·32	·31	·30	·34	·37	·53	—	—	·38
	·70	·65	·62	·70	·46	·48	·41			—	—	·30	·46	·50	—	—	·42	·40
20°S	·54	·54	·57	·58	·60								·42	·57	·45	·42	·48	·52
	·51	·50	·51	·54	·55								·46	·58	·48	·43	·44	·45
	·33	·36	·41	·44	·53			—	—				·47	·55	·48	·41	·38	·39
	·34	·34	·34	·34	·43	·44	·32	·30	·31	·30	·32	·31	·44	·47	·40	·37	·29	·31
40°S	·32	·33	·30	·22	·25	·22	·22	·22	·24	·24	·26	·25	—	·26	·30	·31	·23	·25
	·18	·20	·18	·16	·25	·27	·23	—	—	—	—	—	—	—	—	—	·21	·24
	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
60°S																		

	90°W					60°W						30°W						0°
0°	·18	·19									·43	·43	·46	·39	·28	·31	·26	·26
	·31	·08	·06									·49	·56	—	—	—	·38	·38
	—	—	·11								·45	·52	·63	—	·58	·49	·41	·42
	—	—	—	·08							·42	·50	·55	—	—	·44	—	·36
20°S	—	—	—	·17						·27	·44	·46	·38	—	—	—	·38	·50
	—	—	—	·17					·34	·36	·45	·40	·28	·30	—	·41	·39	·42
	—	—	—	·10				·27	·38	·42	·35	·38	·30	·34	·42	·40	·36	·39
	—	—	—	—			·20	·27	·38	·46	·34	·32	·31	·29	—	·34	·41	·45
40°S	—	—	—	—		·14	·08	·29	·17	·18	·30	—	·20	·23	—	—	·30	—
	—	—	—	—	—	·13	·11	·22	—	—	·22	—	—	—	—	—	—	—
	—	—	—	—	·18	·18	·14	·11	—	—	—	—	—	—	—	—	—	—
	—	—	—	—	·23	—	—	—	—	—	—	—	—	—	—	—	—	—
60°S																		

December, January and February

centimetres per day

	90°E					120°E						150°E						180°E
0°	·43	·35	—	·26	·30	·34	—	·19	·22	·22	·31	·28	·27	—	—	—	—	—
	·40	·38	·42	·38	·51	·38	·26	·38	·32	·28	·35	·21	·27	·32	·54	·60	—	—
	·54	·48	·58	·54	·46	·46	·34	·33	—	·35	·35	·32	·35	·31	·38	·38	—	·36
	·65	·55	·57	·66	·45	·42	·39			—	—	·31	·38	·40	—	·42	·37	·40
20°S	·54	·53	·50	·58	·52								·39	·44	·34	·39	·42	·45
	·51	·50	·49	·54	·50								·46	·54	·42	·39	·35	·37
	·30	·30	·40	·42	·46			—	—				·37	·47	·41	·33	·30	·34
	·29	·25	·29	·30	·34	·33	·31	·30	·31	·32	·29	·31	·32	·34	·33	·26	·25	·30
40°S	·19	·18	·21	·18	·25	·25	·22	·21	·22	·26	·23	·21	·32	·25	·19	·27	·21	·21
	·15	·14	·20	·22	·27	·22	·22	·10	—	—	—	—	·30	·12	·17	·18	·20	·20
	·06	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
60°S																		

TABLE II—MEAN EVAPORATION

December, January and February

	180°W						150°W						120°W						90°W
							centimetres per day												
0°																			
	—	·42	·38	·37	·46	·48	—	·42	—	—	—	—	·25	·21	·17	·14	·14	·15	
	—	·45	·46	—	·43	—	·50	·54	·42	·48	·50	·42	·45	·25	·38	·36	·33	—	
	·35	·35	·47	—	·40	·40	·45	·58	·50	—	·78	·51	·51	·46	·45	·44	—	—	
	·45	·38	·40	—	—	·43	·34	—	·58	·57	·46	·40	·33	·41	·57	·54	·55	—	
20°S																			
	·41	·44	·28	·39	·41	·36	·39	·43	·36	·26	·40	·39	·52	·41	·48	—	—	—	
	·31	·34	·38	·45	·35	·27	·35	·34	·30	—	·35	·35	·42	·39	—	—	—	—	
	·34	·39	·39	·34	·26	·30	—	—	·24	·26	·24	·34	·54	—	—	—	—	—	
	·34	·31	·27	·27	·22	·30	—	—	·27	·22	—	—	—	—	—	—	—	—	
40°S																			
	·28	·27	·22	·14	·20	·12	·17	·22	—	—	—	—	—	—	—	—	—	—	
	·22	·29	·24	·23	·26	·22	·18	—	—	—	—	—	—	—	—	—	—	—	
	—	—	·34	·24	·18	—	—	·17	·16	·18	·14	·20	·21	·14	·14	·14	·18	·09	
	—	—	—	—	—	—	—	—	·15	·14	·08	·07	·10	·12	·22	·13	·14	·20	
60°S																			

March, April and May

	0°						30°E						60°E						90°E
							centimetres per day												
0°																			
	·30	·25							·32	·36	·37	·34	·33	·31	·33	·34	·42	·40	
	·42	·29	·17						·37	·45	·40	·37	·34	·32	·33	·34	·46	·46	
	·46	—	·24						·38	·34	·50	·56	·36	·41	·60	·66	·62	·57	
	·42	·33	·17					·50	·42		·50	·49	·54	·70	·90	·82	·71	·60	
20°S																			
	·31	·23	·15					·63	·48	·50	·54	·54	·63	·72	·97	·86	·93	·67	
	·30	·25	·22				·57	·63	·58	·58	·62	·50	·62	·66	·77	·82	·81	·69	
	·49	·44	·34	·26		·42	·60	·58	·48	·46	·32	·40	·38	·41	·37	·35	·42	·43	
	·49	·46	·50	·32	·43	·49	·58	·55	·52	·51	·49	·50	·45	·39	·36	·35	·35	·38	
40°S																			
	—	·44	—	—	—	—	·42	·22	·13	·12	·18	·31	·42	·34	·36	·39	·34	·31	
	—	—	—	—	—	—	—	—	—	—	—	·22	·21	·14	·16	·22	·22	·20	
	—	—	—	—	—	—	·04	·05	—	—	—	—	·29	·26	·06	·08	·22	·30	
	—	—	—	—	—	—	—	—	·14	—	—	—	—	—	—	—	—	—	
60°S																			

	180°W						150°W						120°W						90°W
							centimetres per day												
0°																			
	—	·42	·26	—	—	—	—	·38	—	—	—	—	·53	·37	·15	·22	·22	·23	
	—	·42	—	—	—	—	·46	·46	—	·50	·50	·47	—	·35	·42	·46	·42	·42	
	·46	·51	·46	·50	·35	·46	·42	·45	·50	—	—	·62	·49	·42	·51	·50	·49	·56	
	·42	·45	—	·55	·44	·45	·48	—	·55	·47	·48	·46	·42	·43	·36	·46	·53	—	
20°S																			
	·54	·44	·46	·55	·50	·42	·33	·41	·56	·45	·43	·50	·48	·37	·34	—	—	—	
	·60	·50	·54	·54	—	·50	·58	—	·45	·37	·52	·50	·57	·50	—	—	—	—	
	·42	·49	·43	·45	·50	·48	·33	·38	·50	·51	·42	·44	·50	—	—	—	—	—	
	·42	·41	·46	·49	·45	·41	·45	·38	·38	·34	·42	—	—	—	—	—	—	—	
40°S																			
	·30	·28	·22	·27	·31	·26	·38	·44	·45	—	—	—	—	—	—	—	—	—	
	·25	·22	·21	·22	·23	·26	·49	—	·42	—	—	—	—	—	—	—	—	—	
	—	—	—	—	—	—	·10	·10	·23	·16	·39	·19	·24	·23	·32	·20	·11	·26	
	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
60°S																			

FROM SEA SURFACE—*contd.*

December, January and February

centimetres per day

	90°W					60°W						30°W						0°
0°	·16	·16									·43	·41	·40	·32	·23	·36	·30	·24
	·28	·06	·04									·50	·51	—	·42	—	·31	·26
	—	—	·02								·49	·50	·62	·62	·54	·38	·27	·30
	—	—	·12	·09							·43	·52	·53	—	·48	·42	—	·30
20°S																		
	—	—	—	·17						·22	·38	·39	·42	·44	—	·36	·40	·45
	—	—	—	·15					·34	·30	·37	·38	·37	·35	·36	·38	·27	·33
	—	—	—	·10				·30	·36	·42	·20	·20	·14	·20	·26	·33	·34	·28
	—	—	—	—			·26	·32	·36	·36	·34	·33	·30	·26	·32	·35	·46	·58
40°S																		
	—	—	—	·14		·18	·07	·15	·10	·17	·24	·26	·10	·09	·06	·21	·26	·46
	—	—	·30	—	—	·09	·14	·21	·22	·14	·22	—	—	·24	·00	·01	—	—
	—	—	—	—	·18	·13	·10	·08	·03	·04	·04	*·04*	—	—	—	—	—	—
	·13	·16	·13	·15	·17	·11	·04	·02	·06	·08	·01	·02	·02	·02	—	—	—	—
60°S																		

March, April and May

centimetres per day

	90°E					120°E						150°E						180°E
0°																		
	·43	·38	—	·22	·28	·28	—	·25	·28	·29	·26	·26	·31	·39	—	·30	—	—
	·41	·46	·42	·42	·41	·30	·32	·30	·34	·32	—	·27	·30	—	·34	·34	—	—
	·54	·52	·60	·58	·48	·45	·38	·36	·40	·42	·27	·32	·39	·42	·46	—	—	·52
	·60	·59	·57	·62	·48	·54	·45			—	—	·31	·54	·47	·55	·52	·51	·49
20°S																		
	·54	·55	·57	·55	·59								·52	·63	·58	·44	·59	·60
	·54	·51	·50	·53	·55								·55	·63	·58	·50	·57	·54
	·35	·39	·38	·37	·51			—	—				·56	·62	·57	·48	·41	·41
	·36	·38	·33	·32	·49	·49	·30	·29	·33	·29	·37	·39	·54	·62	·47	·39	·30	·34
40°S																		
	·22	·26	·22	·21	·21	·16	·26	·26	·23	·18	·30	·30	·20	·26	·42	·32	·24	·25
	·14	·15	·21	·22	·22	·18	·26	·21	—	—	—	—	—	—	·40	·40	·21	·22
	·04	·09	·02	·02	—	—	—	—	—	—	—	—	—	—	—	-	—	—
	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—		—	—
60°S																		

centimetres per day

	90°W					60°W						30°W						0°
0°																		
	·14	·11									·39	·40	·44	·39	·30	·30	·30	·27
	·04	·06	·05									·48	·59	·56	·41	·37	·38	·46
	—	—	·14								·45	·56	·60	—	·82	·60	·49	·49
	—	—	—	·06							·44	·54	·60	—	—	·66	·42	·42
20°S																		
	—	—	—	·16						·36	·48	·56	·58	·31	—	·32	·35	·74
	—	—	—	·17					·33	·42	·38	·49	·37	·33	-	·43	·48	·54
	—	—	—	·12				·33	·37	·43	·38	·57	·19	·34	·50	·41	·45	·54
	—	—	—	—			·25	·34	·22	·55	·41	·42	·30	·54	·52	·42	·43	·47
40°S																		
	—	—	—	·18		·13	·09	·12	·16	·28	·18	·25	·06	·18	—	·11	·34	·40
	—	—	·26	—	—	·15	·10	·25	·27	·33	·26	·30	·18	·22	—	—	—	—
	—	—	·23	—	·17	·27	·18	·12	·10	·14	·16	·09	—	—	—	—	—	—
	—	—	·18	·18	·29	·26	·06	·06	·07	·11	·12	·06	·08	—	—	—	—	—
60°S																		

TABLE II—MEAN EVAPORATION

June, July and August

	0°			30°E							60°E						90°E
							centimetres per day										
0°																	
	·22	·14						·49	·48	·42	·46	·43	·42	·42	·49	·45	·52
	·38	·27	·06					·45	·55	·36	·38	·42	·41	·46	·57	·71	·58
	·43	·40	·14					·47	·51	·49	·58	·66	·71	·71	·74	·73	·76
	·39	·27	·14				·42	·48		·49	·60	·77	·78	·84	·89	·78	·79
20°S																	
	·37	·33	·17				·49	·43	·54	·61	·60	·65	·66	·67	·84	·80	·72
	·38	·45	·20				·51	·50	·46	·53	·50	·51	·55	·61	·65	·70	·66	·54
	—	·38	·28	·32		·63	·64	·61	·43	·46	·46	·42	·43	·44	·50	·45	·45	·43
	·50	·35	·51	·43	·61	·66	·73	·70	·63	·68	·68	·61	·44	·43	·48	·46	·42	·41
40°S																		
	—	—	—	—	—	—	·32	·20	·14	·15	·30	·49	·46	·34	·45	·41	·38	·41
	—	—	—	—	—	—	—	—	—	—	·06	·19	·26	·15	·21	·26	·28	·31
	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
60°S																		

	180°W			150°W							120°W						90°W
							centimetres per day										
0°																	
	·50	·46	·62	·52	·60	·58	—	·58	—	—	—	—	·40	·30	·41	·25	·32	·26
	—	·48	·63	·54	·43	—	·58	·59	·46	·58	·52	·58	·51	·59	·37	·51	·47	·44
	·50	·38	·48	·54	·55	·54	·56	·59	·50	·64	—	·61	·68	·63	·61	·69	·61	·62
	·52	·41	·44	·51	·45	·44	·49	—	·69	·70	·60	·49	·46	·47	·55	·52	—	—
20°S																		
	·39	·43	·38	·46	·53	·50	·55	·55	·40	·44	·50	·44	·49	·49	·48	—	—	—
	·52	·53	·50	·52	·64	·40	·50	·47	—	·44	·39	·41	·69	—	—	—	—	—
	·50	·46	·41	·49	·43	·38	·50	·42	·38	·44	·38	·40	—	—	—	—	—	—
	·47	·41	·38	·40	·33	·35	·38	·34	·35	—	—	—	—	—	—	—	—	—
40°S																		
	·41	·43	·34	·34	·30	·36	·47	—	—	—	—	—	—	—	—	—	—	—
	·28	·37	·36	·34	·39	·41	·27	—	—	—	—	—	—	—	—	—	—	—
	—	—	·36	·30	·30	·35	·30	·21	·18	·18	·25	·26	·14	·18	·26	·23	·23	·26
	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	·20	·23
60°S																		

September, October and November

	0°			30°E							60°E						90°E
							centimetres per day										
0°																	
	·33	·27						·26	·30	·33	·24	·38	·37	·41	·46	·46	·44
	·31	·30	·12					·26	·27	·29	·34	·46	·42	·42	·50	·58	·51
	·37	·30	·19					·24	·28	·37	·49	·54	·56	·64	·63	·72	·80
	·33	·30	·14				·36	·25		·35	·48	·54	·61	·72	·71	·72	·75
20°S																	
	·36	·36	·14				·34	·35	·31	·34	·38	·50	·50	·37	·52	·77	·72
	·38	·29	·23				·46	·42	·39	·42	·34	·34	·42	·38	·40	·45	·58	·47
	·27	·34	·32	·28		·41	·49	·43	·44	·42	·39	·31	·31	·30	·31	·37	·29	·24
	·26	·30	·43	·38	·50	·47	·46	·42	·46	·49	·44	·42	·41	·41	·37	·40	·34	·25
40°S																		
	—	—	·51	·52	—	—	·24	·19	·19	·19	·28	·42	·45	·38	·41	·34	·30	·34
	—	—	·10	—	—	—	—	—	·01	·02	·04	·10	·23	·16	·22	·22	·18	·24
	·12	·08	—	—	—	—	—	—	—	—	—	·14	·01	·18	·10	·04	·07	·20
	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
60°S																		

FROM SEA SURFACE—*contd.*

June, July and August

	90°E				120°E					150°E					180°E	
							centimetres per day									
0°																
	·44	·42	—	·35	·41	·38	—	·23	·29	—	·22	·23	·36	—	—	·34	·24	—
	·50	·50	·54	·62	·38	·35	·38	·34	·35	·35	·46	·28	·34	·29	·37	·46	—	·24
	·68	·70	·74	·77	·42	·41	·44	·33	·28	·27	·32	·33	·37	·38	·64	·57	·43	·36
	·77	·73	·71	·82	·50	·59	·50			—	—	·35	·47	·58	·82	·50	·34	·37
20°S																		
	·54	·56	·65	·62	·66								·42	·59	·51	·47	·49	·59
	·50	·53	·57	·58	·65								·48	·63	·50	·46	·54	·56
	·40	·41	·42	·50	·66			—	—				·54	·60	·57	·48	·48	·52
	·37	·40	·38	·38	·54	·58	·40	·35	·32	·34	·37	·30	·54	·54	·40	·49	·35	·38
40°S																		
	·37	·32	·32	·27	·29	·26	·19	·21	·28	·26	·26	·21	·34	·29	·35	·43	·23	·26
	·21	·19	·14	·14	·26	·27	·22	—	—	—	—	—	—	—	·24	·26	·26	·23
	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
60°S																		

	90°W				60°W					30°W					0°	
							centimetres per day									
0°																
	·23	·23								·45	·43	·49	·45	·30	·30	·18	·21
	·36	·09	·11								·50	·62	—	—	·50	·41	·40
	—	—	·18							·51	·62	·69	·76	·62	·71	·52	·57
	—	—	—	·08						·46	·54	·60	—	—	·52	·40	·44
20°S																	
	—	—	—	·19					·30	·46	·43	·31	—	—	—	·44	·48
	—	—	—	·17				·36	·37	·52	·40	·24	·22	·57	·50	·51	·44
	—	—	—	·10			·17	·40	·47	·44	·38	·48	·51	·50	·49	·38	·46
	—	—	—	·20		·12	·14	·61	·57	·19	·12	·30	·14	—	·35	·38	·35
40°S																	
	—	—	—	—	·14	·06	·42	·21	·18	·39	—	·15	·26	·63	·53	·26	—
	—	—	—	—	—	·14	·12	·25	—	—	·18	·26	—	—	—	—	—	—
	—	—	—	—	·21	·15	·15	·22	—	—	—	—	—	—	—	—	—	—
	·25	·23	·23	·28	·29	—	—	—	—	—	—	—	—	—	—	—	—	—
60°S																		

September, October and November

	90°E				120°E					150°E					180°E	
							centimetres per day									
0°																
	·42	·41	—	·34	·38	·33	—	·23	·19	—	·34	·29	·27	—	—	·37	—	—
	·44	·45	·50	·50	·38	·30	·30	·28	·22	·32	·20	·21	·26	—	·57	·43	—	—
	·77	·64	·59	·70	·45	·37	·26	·22	·18	·24	·32	·24	·27	·38	·63	·52	·40	·30
	·78	·74	·66	·70	·39	·37	·27			—	—	·23	·42	·53	·70	—	·48	·35
20°S																		
	·53	·54	·57	·56	·62								·37	·59	·36	·35	·43	·42
	·51	·46	·50	·50	·53								·37	·51	·43	·38	·30	·33
	·26	·31	·40	·46	·49			—	—				·43	·50	·38	·35	·30	·29
	·27	·30	·28	·32	·37	·38	·29	·28	·27	·28	·26	·25	·34	·38	·31	·32	·24	·25
40°S																		
	·34	·35	·33	·30	·29	·29	·22	·20	·24	·25	·25	·26	—	·26	·25	·28	·23	·26
	·24	·21	·14	·12	·20	·20	·23	·30	—	—	—	—	—	—	—	—	·18	·31
	·25	·18	·10	·06	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
60°S																		

TABLE II—MEAN EVAPORATION

September, October and November

	180°W				150°W							120°W						90°W	
							centimetres per day												
0°																			
	—	·54	·39	·42	—	—	·42	·38	—	—	—	·29	·28	·17	·18	·18	·19	·19	
	—	·53	·51	—	·58	—	·46	·50	·49	·47	·43	·46	·44	·48	·44	·38	·36	·28	
	·43	·41	·46	·33	·45	·46	·49	·51	·58	—	—	·58	·48	·54	·54	·57	·54	·50	
	·46	·41	·54	·49	·52	·54	·46	—	·55	·60	·51	·50	·44	·46	·49	·58	—	—	
20°S																			
	·32	·37	·50	·53	—	·51	·46	·50	·45	·43	·40	·41	·40	·40	·41	—	—	—	
	·31	·36	·38	·41	·40	·34	·36	·36	·38	·35	·34	·23	·29	—	—	—	—	—	
	·33	·30	·29	·34	—	·30	·30	·29	·32	·33	·22	·22	—	—	—	—	—	—	
	·31	·28	·21	·22	·23	·24	·30	·23	·17	·15	—	—	—	—	—	—	—	—	
40°S																			
	·25	·37	·28	·28	·22	·22	—	·14	—	—	—	—	—	—	—	—	—	—	
	—	·27	·24	·25	·25	·22	·20	·21	·28	·29	—	—	—	—	—	—	—	—	
	—	—	—	—	·19	—	·11	·16	·14	·16	·12	·21	·22	·17	·10	·17	·14	·21	
	—	—	—	—	—	—	—	—	—	—	·08	·07	—	—	—	—	—	—	
60°S																			

TABLE III—MEAN QUANTITY OF SENSIBLE

Annual

	0°				30°E							60°E						90°E	
							calories per square centimetre per day												
0°																			
	9	5							3	3	4	6	10	8	11	10	11	13	
	10	10	*2*						4	4	0	5	14	9	9	13	17	14	
	4	—	18						7	7	2	6	12	14	11	10	11	15	
	1	*2*	4				.	10	6		1	14	15	24	20	17	12	13	
20°S																			
	4	3	*4*					13	10	14	13	16	23	30	28	34	41	30	
	18	14	*10*				18	18	18	18	18	22	26	28	36	40	38	34	
	—	18	14	3		18	42	36	28	26	27	28	23	23	29	26	30	29	
	50	38	48	7	34	36	55	52	54	54	58	55	38	31	31	33	31	27	
40°S																			
	—	—	—	—	—	—	27	7	*14*	*6*	23	62	61	34	46	43	33	34	
	—	—	—	—	—	—	—	—	—	—	—	14	17	*9*	10	14	15	31	
	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
60°S																			

	180°W				150°W							120°W						90°W	
							calories per square centimetre per day												
0°																			
	—	9	7	—	—	—	—	6	—	—	—	—	*6*	*4*	*2*	*1*	*1*	2	
	—	13	—	—	—	—	6	8	—	*6*	*9*	*6*	—	2	2	2	7	—	
	13	13	9	—	6	9	9	3	*2*	—	—	9	2	6	12	12	—	—	
	12	10	—	—	—	13	18	—	6	8	12	11	10	11	13	18	—	—	
20°S																			
	14	20	19	21	—	20	23	19	16	10	11	9	16	14	6	—	—	—	
	18	20	22	22	—	22	25	—	—	—	13	14	15	—	—	—	—	—	
	22	22	23	21	—	22	—	—	12	21	12	8	—	—	—	—	—	—	
	29	24	23	24	28	27	—	—	13	—	—	—	—	—	—	—	—	—	
40°S																			
	34	36	32	27	21	23	—	—	—	—	—	—	—	—	—	—	—	—	
	—	35	31	37	34	30	43	—	—	—	—	—	—	—	—	—	—	—	
	—	—	—	—	—	—	—	28	17	23	22	30	16	19	16	25	21	16	
	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
60°S																			

FROM SEA SURFACE—*contd.*

September, October and November

	90°W					60°W						30°W						0°
						centimetres per day												
0°																		
	·22	·26								·46	·48	·49	·42	·31	·29	·30	·33	
	·25	·10	·02								·44	·51	—	·42	·42	·41	·42	
	—	—	·09							·35	·39	·62	·61	·58	·54	·34	·34	
	—	—	—	·10						·35	·38	·46	—	—	·36	—	·29	
20°S																		
	—	—	—	·14					·22	·44	·46	·22	—	—	·20	·34	·37	
	—	—	—	·18				·35	·38	·53	·34	·16	·30	·30	·31	·29	·36	
	—	—	—	·09			·30	·38	·39	·38	·40	·35	·31	·41	·38	·29	·28	
	—	—	—	·11		·17	·28	·33	·34	·44	·41	·35	·22	·26	·26	·37	·38	
40°S																		
	—	—	—	·26	·10	·09	·22	·18	·11	·38	—	·48	·39	—	—	·35	—	
	—	—	·20	—	— ·14	·07	·18	—	—	·19	—	—	—	—	—	·18	—	
	—	—	—	—	·18 ·18	·11	·03	—	·04	·00	·00	—	—	—	—	·02	·02	
	·18	·21	—	—	·18 —	·02	—	—	·05	—	—	·08	—	—	—	·11	·07	
60°S																		

HEAT EXCHANGED BETWEEN SEA AND AIR

Annual

	90°E					120°E						150°E						180°E
						calories per square centimetre per day												
0°																		
	18	17	—	7	4	4	—	2	6	—	7	8	17	—	—	—	—	—
	14	17	16	13	6	*4*	*5*	*6*	3	*3*	—	3	10	—	11	18	—	—
	16	10	17	22	8	3	1	3	*2*	*2*	*6*	2	9	10	*21*	—	—	10
	21	18	17	26	11	14	6			—	—	3	8	15	—	—	15	12
20°S																		
	20	19	20	17	20								9	24	21	10	20	22
	28	31	25	25	28								23	29	20	18	18	17
	24	28	32	39	46			—	—				32	37	32	26	20	21
	27	31	26	26	45	44	23	21	22	18	22	12	31	38	32	29	20	20
40°S																		
	33	33	24	1	18	15	11	9	10	10	12	10	—	20	28	28	1	17
	10	10	1	*1*	22	19	20	—	—	—	—	—	—	—	—	—	14	19
	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
60°S																		

	90°W					60°W						30°W						0°
						calories per square centimetre per day												
0°																		
	5	7								4	5	7	4	*7*	*4*	*5*	*4*	
	12	*8*	*7*								5	11	—	—	—	2	2	
	—	—	*4*							5	6	3	—	18	10	1	0	
	—	—	—	*5*						5	11	8	—	—	16	—	0	
20°S																		
	—	—	—	7					7	9	8	*2*	—	—	—	17	18	
	—	—	—	2				14	15	12	2	*12*	*13*	—	19	20	19	
	—	—	—	*8*			4	15	27	17	17	10	22	24	22	24	30	
	—	—	—	—		3	13	43	42	10	2	14	8	—	22	38	43	
40°S																		
	—	—	—	—	*17*	*22*	34	11	16	36	—	*6*	18	—	—	53	—	
	—	—	—	—	— *15*	*10*	33	—	—	22	—	—	—	—	—	—	—	
	—	—	—	—	4 *9*	15	17	—	—	—	—	—	—	—	—	—	—	
	—	—	—	—	61 —	—	—	—	—	—	—	—	—	—	—	—	—	
60°S																		

TABLE III—MEAN QUANTITY OF SENSIBLE

December, January and February

calories per square centimetre per day

	0°						30°E						60°E						90°E
0°	10	4							2	4	0	3	7	7	9	10	13	12	
	3	7	*5*						2	4	1	1	10	7	14	14	18	15	
	2	*2*	14						10	6	3	12	6	8	17	10	7	13	
	3	*3*	2					5	2		*7*	4	12	20	20	17	8	10	
20°S	*15*	0	*9*					6	14	13	*2*	6	18	29	2	12	11	*4*	
	8	2	*20*				13	12	16	16	10	27	14	18	18	20	1	2	
	6	*8*	14	*17*		0	28	30	14	14	10	10	6	5	7	4	18	22	
	73	60	34	*13*	17	15	37	30	34	34	19	14	19	12	11	19	22	15	
40°S	9	*17*	—	—	—	—	40	14	*43*	*18*	*8*	18	31	14	6	*5*	*7*	*2*	
	60	155	—	—	—	—	—	—	—	—	*42*	*12*	*30*	*42*	*34*	*32*	*15*	6	
	—	—	—	—	—	—	—	—	—	—	0	*33*	—	—	—	—	—	—	
	18	—	—	—	*18*	*28*	—	*19*	*14*	*8*	—	—	—	—	—	—	18	*20*	
60°S																			

	180°W						150°W						120°W						90°W
0°	—	10	*1*	*2*	10	4	—	4	—	—	—	—	*6*	*8*	*4*	*2*	*9*	0	
	—	12	11	—	0	—	10	6	0	*18*	*19*	*16*	*5*	*3*	*2*	0	3	—	
	9	15	13	—	16	10	6	2	*3*	—	18	7	*7*	*7*	9	6	—	—	
	8	12	14	—	—	9	21	—	15	13	7	16	5	6	10	18	16	—	
20°S	4	17	9	9	14	9	9	5	11	7	3	6	10	11	2	—	—	—	
	2	3	5	14	7	8	12	6	9	—	2	2	5	1	—	—	—	—	
	7	10	10	2	6	6	—	—	2	*2*	*2*	1	25	—	—	—	—	—	
	13	10	4	6	7	10	—	—	*4*	2	—	—	—	—	—	—	—	—	
40°S	17	16	6	10	2	2	0	*14*	—	—	—	—	—	—	—	—	—	—	
	18	21	10	14	6	6	*11*	—	—	—	—	—	—	—	—	—	—	—	
	—	—	72	22	10	—	—	9	*5*	5	*9*	2	*5*	*12*	*4*	0	5	*43*	
	—	—	—	—	—	—	—	—	15	17	19	6	*23*	*2*	*10*	*19*	2	14	
60°S																			

March, April and May

calories per square centimetre per day

	0°						30°E						60°E						90°E
0°	9	6							4	6	6	7	7	6	2	1	11	13	
	10	7	1						10	10	6	6	8	7	5	6	14	11	
	2	—	19						10	4	1	7	8	6	8	7	8	2	
	2	*8*	1					13	7		2	17	18	32	19	6	6	3	
20°S	6	0	1					18	10	10	15	26	23	34	58	53	44	27	
	22	10	*14*				22	19	17	20	26	18	34	38	46	54	57	55	
	35	32	9	4		13	40	34	26	26	26	30	26	26	19	17	28	28	
	48	34	40	*4*	24	25	56	54	46	46	55	65	42	34	33	26	32	36	
40°S	—	30	—	—	—	—	44	14	*10*	*9*	10	42	54	37	39	66	37	31	
	—	—	—	—	—	—	—	—	—	—	—	34	19	1	7	18	13	8	
	—	—	—	—	—	—	*10*	0	—	—	—	—	65	32	12	*35*	27	79	
	—	—	—	—	—	—	—	—	*19*	—	—	—	—	—	—	—	—	—	
60°S																			

HEAT EXCHANGED BETWEEN SEA AND AIR—*contd.*

December, January and February

	90°E					120°E							150°E					180°E
	calories per square centimetre per day																	
0°																		
	17	16	—	6	6	12	—	2	9	6	9	10	13	—	—	—	—	—
	14	18	21	18	15	6	3	7	4	0	9	2	7	13	23	25	—	—
	13	3	17	14	2	7	1	2	—	4	5	4	18	3	5	12	—	6
	10	1	15	22	3	3	4			—	—	1	5	6	—	12	15	10
20°S																		
	6	10	4	9	3								*4*	17	15	3	11	8
	14	11	6	10	2								11	17	6	4	6	2
	18	16	22	28	20			—	—				5	13	15	12	4	8
	18	11	12	15	20	16	14	13	14	12	6	4	2	6	10	10	7	8
40°S																		
	5	*10*	2	3	12	9	*2*	*8*	6	14	14	6	16	12	8	*10*	0	4
	7	*11*	*9*	*6*	13	11	0	*15*	—	—	—	—	18	0	8	6	*6*	*5*
	8	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
60°S																		

	90°W					60°W							30°W					0°
	calories per square centimetre per day																	
0°																		
	2	3									10	6	5	4	*3*	*2*	*14*	0
	12	*6*	*6*									6	7	—	2	—	*4*	*3*
	—	—	*18*								6	1	15	*6*	2	*8*	*5*	*5*
	—	—	*15*	*5*							3	7	11	—	5	7	—	*4*
20°S																		
	—	—	—	2						*4*	1	4	0	*6*	—	16	6	3
	—	—	—	5					4	6	6	8	*2*	2	3	8	3	4
	—	—	—	*6*				*10*	2	5	*14*	*11*	*33*	*18*	*19*	*6*	*9*	*2*
	—	—	—	—			*17*	*2*	22	21	7	7	4	7	7	18	31	38
40°S																		
	—	—	—	4		*45*	*22*	24	*9*	*4*	2	15	*22*	0	*12*	6	36	86
	—	—	31	—	—	*40*	*14*	*7*	10	7	9	—	—	63	*92*	*57*	—	—
	—	—	—	—	*29*	*38*	*9*	*13*	*23*	*13*	*11*	*11*	—	—	—	—	—	—
	18	18	*7*	14	4	11	*9*	0	15	17	*2*	*9*	*7*	*4*	—	—	—	—
60°S																		

March, April and May

	90°E					120°E							150°E					180°E
	calories per square centimetre per day																	
0°																		
	20	14	—	4	7	6	—	5	15	18	6	9	12	10	—	6	—	—
	14	15	11	13	12	*4*	5	2	6	2	—	*4*	10	—	0	10	—	—
	13	8	15	21	11	3	*2*	*6*	*1*	*2*	*7*	6	10	11	*14*	—	—	20
	14	17	10	21	11	16	11			—	—	5	10	16	*55*	*31*	16	14
20°S																		
	18	11	18	5	17								8	20	19	14	26	28
	30	38	18	19	23								25	34	22	22	22	19
	19	29	23	28	41			—	—				41	41	36	33	23	18
	31	37	28	19	49	46	18	15	26	17	22	22	52	58	37	32	22	22
40°S																		
	15	17	9	1	5	5	16	13	*2*	*6*	7	18	*18*	21	46	42	2	18
	6	0	7	10	2	13	30	23	—	—	—	—	—	—	57	63	29	22
	30	*2*	0	*2*	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
60°S																		

TABLE III—MEAN QUANTITY OF SENSIBLE HEAT

March, April and May

	180°W						150°W						120°W						90°W
	calories per square centimetre per day																		
0°																			
	—	10	10	—	—	—	—	—	—	—	—	—	*2*	2	*2*	0	5	2	
	—	12	—	—	—	—	5	9	—	*8*	*8*	9	—	2	6	7	3	6	
	19	14	16	9	0	4	4	*1*	*6*	—	—	12	3	4	10	10	12	6	
	12	7	—	13	2	13	17	—	15	2	7	2	8	8	9	18	11	—	
20°S																			
	22	22	18	26	24	18	17	20	21	6	16	6	25	11	12	—	—	—	
	27	23	24	26	—	19	34	—	22	23	20	19	26	18	—	—	—	—	
	31	30	26	31	34	31	28	23	18	26	24	22	14	—	—	—	—	—	
	31	29	36	36	38	36	27	30	22	28	13	—	—	—	—	—	—	—	
40°S																			
	34	32	30	25	27	23	60	90	62	—	—	—	—	—	—	—	—	—	
	34	24	20	23	20	16	120	—	107	—	—	—	—	—	—	—	—	—	
	—	—	—	—	—	—	*2*	5	5	24	37	34	21	22	26	36	8	10	
	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
60°S																			

June, July and August

	0°						30°E						60°E						90°E
	calories per square centimetre per day																		
0°																			
	6	2							7	5	12	17	9	12	18	19	9	14	
	10	10	*5*						6	9	0	12	15	10	9	17	21	16	
	15	23	18						13	17	*4*	8	26	32	6	11	18	30	
	10	10	10					12	14		*3*	21	26	41	22	26	27	26	
20°S																			
	21	14	*4*					20	14	31	38	35	38	42	40	55	85	62	
	39	35	1				28	29	26	31	32	34	38	46	57	62	60	50	
	—	34	25	17		42	63	51	34	33	43	42	42	40	51	44	54	53	
	63	24	65	34	62	69	84	82	82	84	103	86	46	44	56	50	45	42	
40°S																			
	—	—	—	—	—	—	23	3	*6*	6	63	115	83	47	80	69	70	69	
	—	—	—	—	—	—	—	—	—	—	*12*	39	42	*2*	34	34	50	55	
	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
60°S																			

	180°W						150°W						120°W						90°W
	calories per square centimetre per day																		
0°																			
	10	7	10	6	*8*	*4*	—	6	—	—	—	—	*14*	*6*	0	6	0	5	
	—	9	6	7	*6*	—	6	12	10	11	*2*	*10*	*2*	14	5	10	13	15	
	10	11	0	11	7	12	15	10	2	*11*	—	14	12	14	23	18	28	42	
	15	14	19	28	14	19	19	—	22	10	27	19	20	19	18	14	—	—	
20°S																			
	19	22	26	24	27	33	39	26	18	15	14	15	22	25	13	—	—	—	
	39	39	43	34	35	43	38	34	—	29	24	27	26	—	—	—	—	—	
	38	40	44	42	43	38	38	35	26	41	24	19	—	—	—	—	—	—	
	50	46	46	47	38	34	37	34	29	—	—	—	—	—	—	—	—	—	
40°S																			
	66	75	66	55	48	58	62	—	—	—	—	—	—	—	—	—	—	—	
	42	73	84	76	91	81	59	—	—	—	—	—	—	—	—	—	—	—	
	—	—	96	73	75	83	62	60	54	50	45	44	26	44	46	42	52	61	
	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	55	62	
60°S																			

EXCHANGED BETWEEN SEA AND AIR—*contd.*

March, April and May

	90°W					60°W						30°W						0°
	calories per square centimetre per day																	
0°																		
	1	*3*									2	10	14	2	*9*	*18*	*6*	*12*
	10	*8*	*8*									8	16	2	*5*	*6*	*5*	*2*
	—	—	*2*								6	13	*14*	—	15	10	*3*	*2*
	—	—	—	*6*							5	13	18	—	—	1	*13*	0
20°S																		
	—	—	—	10						15	14	13	8	2	—	10	15	26
	—	—	—	2				7	14	3	*2*		3	3	—	29	22	29
	—	—	—	0			14	22	49	22	33		22	27	38	23	23	38
	—	—	—	—		24	29	24	56	18	17		11	27	31	26	23	25
40°S																		
	—	—	—	19		*20*	*14*	16	50	0	20		*28*	10	—	*5*	61	75
	—	—	34	—	—	*10*	17	17	58	37	54		21	35	—	—	—	—
	—	—	19	—	*2*	11	0	15	17	*7*	0		—	—	—	—	—	—
	—	—	13	25	56	2	14	42	78	6	18		29	—	—	—	—	—
60°S																		

June, July and August

	90°E					120°E						150°E						180°E
	calories per square centimetre per day																	
0°																		
	15	14	—	9	3	*1*	—	2	0	—	4	8	28	—	—	6	*6*	—
	15	19	14	15	0	*10*	*10*	*4*	*3*	3	18	12	18	10	13	15	—	*8*
	19	20	36	43	6	*2*	*2*	*6*	*1*	*5*	*9*	*9*	6	17	*30*	*33*	2	*2*
	34	29	27	41	10	16	4			—	—	9	12	31	*46*	*37*	11	11
20°S																		
	38	37	35	30	39								30	38	42	22	30	37
	40	46	46	42	56								46	48	34	30	34	38
	41	44	47	54	77			—	—				59	64	52	37	40	46
	42	46	46	46	74	78	41	37	38	34	45	27	64	71	58	54	36	41
40°S																		
	52	51	46	21	24	17	20	22	26	20	41	28	29	36	51	59	5	38
	22	30	16	8	30	48	38	—	—	—	—	—	—	—	41	42	46	46
	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
60°S																		

	90°W					60°W						30°W						0°
	calories per square centimetre per day																	
0°																		
	12	14									9	5	4	9	*6*	3	*7*	*2*
	13	*9*	*2*									8	13	—	—	5	2	2
	—	—	7								10	8	10	44	38	26	20	10
	—	—	—	*4*							10	20	9	—	—	25	8	6
20°S																		
	—	—	—	15						6	11	10	*24*	—	—	—	33	33
	—	—	—	14					28	19	23	14	*48*	*50*	42	34	51	27
	—	—	—	*6*				8	26	36	41	16	24	61	65	54	51	63
	—	—	—	27			6	10	89	66	*14*	51	7	*14*	—	30	52	61
40°S																		
	—	—	—	—		2	*22*	118	22	27	101	—	14	47	112	84	34	—
	—	—	—	—	—	8	*2*	71	—	—	17	29	—	—	—	—	—	—
	—	—	—	—	5	42	57	102	—	—	—	—	—	—	—	—	—	—
	72	54	67	78	82	—	—	—	—	—	—	—	—	—	—	—	—	—
60°S																		

TABLE III—MEAN QUANTITY OF SENSIBLE HEAT

September, October and November

calories per square centimetre per day

	0°						30°E						60°E						90°E
0°																			
	12	8							0	*2*	0	*1*	14	7	14	12	10	12	
	15	16	1						*2*	*7*	*6*	0	21	13	10	14	17	14	
	7	10	17						2	3	6	*1*	8	2	14	14	12	16	
	6	*10*	6					10	0		13	11	2	2	20	22	8	12	
20°S																			
	2	*2*	*4*					6	5	3	0	*3*	15	14	14	17	25	33	
	16	2	*7*				11	13	13	6	4	6	20	10	25	25	34	30	
	4	22	10	9		17	34	33	30	30	30	31	21	21	37	30	21	14	
	19	33	53	11	34	28	43	41	55	57	56	55	44	36	25	36	27	14	
40°S																			
	—	—	134	137	—	—	1	*2*	5	*2*	26	73	75	39	59	44	31	38	
	—	—	18	—	—	—	—	—	*21*	*30*	*25*	*4*	36	8	33	36	14	25	
	31	7	—	—	—	—	—	—	—	—	—	*52*	*11*	16	3	*11*	7	41	
	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
60°S																			

calories per square centimetre per day

	180°W						150°W						120°W						90°W
0°																			
	—	8	8	8	—	—	5	5	—	—	—	*8*	*3*	*4*	*1*	1	*1*	2	
	—	6	10	—	*5*	—	0	5	*14*	*7*	*6*	*5*	*18*	*3*	0	*12*	9	10	
	13	10	10	4	1	11	8	2	*3*	—	—	2	2	10	5	18	27	10	
	11	8	6	7	10	15	18	—	*30*	6	6	7	8	12	13	25	—	—	
20°S																			
	13	20	23	28	—	24	26	25	18	12	11	12	9	11	*2*	—	—	—	
	6	14	17	18	24	21	18	22	18	18	10	8	2	—	—	—	—	—	
	13	10	14	11	—	14	19	20	2	17	2	*11*	—	—	—	—	—	—	
	20	11	7	12	10	18	22	15	3	0	—	—	—	—	—	—	—	—	
40°S																			
	21	22	27	22	11	10	—	0	—	—	—	—	—	—	—	—	—	—	
	—	22	14	34	20	19	7	7	43	42	—	—	—	—	—	—	—	—	
	—	—	—	—	34	—	2	23	16	12	18	42	23	23	13	23	20	19	
	—	—	—	—	—	—	—	—	—	—	26	9	—	—	—	—	—	—	
60°S																			

TABLE IV—MEAN TOTAL ENERGY EXCHANGE

Annual

calories per square centimetre per day

	0°						30°E						60°E						90°E
0°																			
	180	136							212	216	214	206	229	229	236	262	262	265	
	218	175	66						218	238	202	210	246	233	238	280	297	297	
	244	—	134						214	222	256	307	304	330	362	390	396	422	
	218	173	92					238	219		254	306	355	406	470	457	430	432	
20°S																			
	203	177	89					302	270	289	295	306	362	402	398	436	491	426	
	211	207	130				307	318	307	314	318	325	331	346	370	402	417	366	
	—	244	203	174		301	392	362	287	279	262	235	232	233	246	244	252	241	
	327	282	333	229	330	351	390	380	354	359	345	318	276	253	250	253	246	226	
40°S																			
	—	—	—	—	—	—	226	130	66	82	158	287	312	233	253	226	209	220	
	—	—	—	—	—	—	—	—	—	—	—	110	129	66	119	126	132	154	
	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
60°S																			

EXCHANGED BETWEEN SEA AND AIR—*contd.*

September, October and November

	90°E						120°E						150°E						180°E
							calories per square centimetre per day												
0°																			
	18	25	—	9	0	0	—	*2*	*1*	—	6	4	13	—	—	13	—	—	
	11	17	18	7	*2*	*7*	*17*	*13*	2	11	*5*	2	5	—	10	25	—	—	
	20	10	0	11	13	5	*1*	*2*	*2*	*4*	*11*	*7*	1	6	*46*	*15*	18	18	
	26	27	17	22	20	22	2			—	—	*2*	2	8	*30*	—	20	12	
20°S																			
	16	19	22	25	21								2	22	5	2	14	14	
	26	28	29	28	29								9	17	17	14	7	10	
	18	25	37	47	46			—	—				25	30	25	20	14	11	
	18	30	20	26	34	36	22	19	11	10	15	*7*	8	18	22	20	14	10	
40°S																			
	58	73	40	29	31	29	11	9	8	11	*14*	*13*	—	12	8	19	*2*	6	
	29	20	*10*	*18*	43	5	14	23	—	—	—	—	—	—	—	—	*14*	10	
	37	29	0	13	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
60°S																			

	90°W						60°W						30°W						0°
							calories per square centimetre per day												
0°																			
	5	14									*3*	*2*	4	2	*9*	*2*	3	*1*	
	14	*7*	*11*									*2*	10	—	*9*	*9*	16	10	
	—	—	*12*								*2*	3	2	10	20	14	*9*	*5*	
	—	—	—	*4*							0	4	*5*	—	—	14	—	*2*	
20°S																			
	—	—	—	2						12	10	5	7	—	—	14	14	11	
	—	—	—	*1*					17	22	14	*10*	*2*	*7*	*10*	6	6	16	
	—	—	—	*18*				4	12	19	19	28	27	20	12	19	30	19	
	—	—	—	0			1	14	38	28	28	34	30	20	18	10	46	50	
40°S																			
	—	—	—	30		*14*	*20*	6	14	*9*	42	—	16	14	—	—	82	—	
	—	—	22	—	—	*18*	*17*	18	—	—	24	—	—	—	—	—	46	—	
	—	—	—	—	*8*	*6*	2	*20*	—	2	*16*	*14*	—	—	—	—	*4*	8	
	27	38	—	—	22	—	*12*	—	—	20	—	—	6	—	—	—	77	49	
60°S																			

BETWEEN SEA AND AIR

Annual

	90°E						120°E						150°E						180°E
							calories per square centimetre per day												
0°																			
	269	246	—	179	205	197	—	131	150	—	174	165	195	—	—	—	—	—	
	268	278	300	294	236	192	178	185	183	174	—	145	187	—	276	287	—	—	
	386	354	378	399	279	252	207	178	167	184	179	180	214	225	286	—	—	236	
	430	399	381	431	295	289	236			—	—	180	274	304	—	—	266	246	
20°S																			
	335	342	354	358	372								260	354	286	254	303	332	
	327	321	324	339	354								294	369	301	271	275	278	
	222	234	267	298	358			—	—				310	358	314	265	242	250	
	220	226	215	227	299	302	218	200	200	198	211	178	286	314	252	243	186	195	
40°S																			
	196	198	182	150	168	160	144	137	151	148	165	150	178	159	211	210	134	159	
	113	113	110	100	150	148	158	—	—	—	—	—	—	—	—	—	142	157	
	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
60°S																			

TABLE IV—MEAN TOTAL ENERGY EXCHANGE

Annual

	180°W						150°W						120°W						90°W
	calories per square centimetre per day																		
0°																			
	—	280	250	—	—	—	—	263	—	—	—	—	181	148	130	117	125	124	
	—	286	—	—	—	—	310	310	—	291	275	274	—	271	236	250	237	—	
	266	255	263	—	262	282	288	314	303	—	—	347	317	305	319	332	—	—	
	281	251	—	—	—	292	276	—	351	350	308	281	252	269	301	323	—	—	
20°S																			
	255	262	254	303	—	285	276	294	275	242	265	263	231	259	254	—	—	—	
	274	271	287	302	—	280	290	—	—	—	246	231	222	—	—	—	—	—	
	250	258	245	258	—	236	—	—	205	247	276	292	—	—	—	—	—	—	
	253	230	218	227	204	212	—	—	183	—	—	—	—	—	—	—	—	—	
40°S																			
	214	220	190	178	173	167	—	—	—	—	—	—	—	—	—	—	—	—	
	—	204	186	188	198	190	209	—	—	—	—	—	—	—	—	—	—	—	
	—	—	—	—	—	—	—	118	120	124	155	156	134	122	138	133	119	132	
	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
60°S																			

December, January and February

	0°						30°E						60°E						90°E
	calories per square centimetre per day																		
0°																			
	191	144							204	191	182	184	222	230	228	243	246	254	
	188	168	54						217	211	198	174	227	218	221	246	254	248	
	225	149	148						194	182	223	263	233	276	293	344	350	378	
	212	178	84					146	194		197	263	282	367	381	390	387	421	
20°S																			
	171	215	95					279	299	271	247	260	329	418	299	323	355	352	
	143	202	163				301	286	303	318	312	326	288	330	294	325	306	338	
	171	208	227	162		238	382	355	258	232	189	179	170	171	198	208	230	221	
	451	380	333	214	276	307	371	354	295	271	226	180	190	174	181	192	231	208	
40°S																			
	187	50	—	—	—	—	260	158	6	58	71	177	250	188	140	106	98	111	
	240	463	—	—	—	—	—	—	—	—	*30*	48	18	*10*	6	1	31	95	
	—	—	—	—	—	—	—	—	—	—	91	96	—	—	—	—	—	—	
	17	—	—	—	10	7	—	0	8	18	—	—	—	—	—	—	57	*6*	
60°S																			

	180°W						150°W						120°W						90°W
	calories per square centimetre per day																		
0°																			
	—	260	223	211	277	286	—	254	—	—	—	—	141	115	94	80	73	88	
	—	275	277	—	254	—	306	318	242	262	270	227	255	140	215	209	193	—	
	214	223	286	—	250	243	267	342	290	—	442	305	290	262	269	262	—	—	
	271	234	246	—	—	259	220	—	351	242	274	250	198	242	344	330	340	—	
20°S																			
	242	258	171	238	254	218	238	259	222	161	237	235	314	251	280	—	—	—	
	185	198	232	276	211	167	218	205	186	—	206	207	248	230	—	—	—	—	
	205	226	238	205	155	180	—	—	144	153	137	196	341	—	—	—	—	—	
	207	191	167	167	138	185	—	—	154	134	—	—	—	—	—	—	—	—	
40°S																			
	182	177	136	96	120	71	100	112	—	—	—	—	—	—	—	—	—	—	
	147	191	152	148	156	127	90	—	—	—	—	—	—	—	—	—	—	—	
	—	—	275	163	115	—	—	108	89	114	78	122	119	65	61	78	111	7	
	—	—	—	—	—	—	—	—	104	102	64	49	37	67	121	72	81	133	
60°S																			

BETWEEN SEA AND AIR—*contd.*

Annual

	90°W					60°W						30°W						0°
	calories per square centimetre per day																	
0°																		
	114	120									256	257	269	233	161	177	151	149
	195	38	25									290	334	—	—	—	224	227
	—	—	61								267	308	381	—	399	337	237	250
	—	—	—	45							250	296	328	—	—	302	—	210
20°S																		
	—	—	—	104					168	267	276		224	—	—	—	241	315
	—	—	—	101				216	229	276	239		154	163	—	257	264	263
	—	—	—	50			163	235	277	223	242		181	222	267	256	234	255
	—	—	—	—		119	170	264	308	210	188		197	178	—	222	278	303
40°S																		
	—	—	—	—		28	203	112	123	209	—		112	154	—	—	230	—
	—	—	—	—	—	52	155	—	—	146	—		—	—	—	—	—	—
	—	—	—	—	111	93	82	—	—	—	—		—	—	—	—	—	—
	—	—	—	—	176	—	—	—	—	—	—		—	—	—	—	—	—
60°S																		

December, January and February

	90°E						120°E						150°E					180°E
	calories per square centimetre per day																	
0°																		
	268	226	—	162	184	206	—	113	141	139	192	175	174	—	—	—	—	—
	253	240	266	236	248	224	150	214	192	162	214	122	190	202	335	317	—	—
	333	289	355	330	312	276	198	193	176	202	208	192	239	188	228	232	—	216
	390	325	350	401	282	253	235			—	—	182	230	239	—	257	232	243
20°S																		
	324	319	300	365	312								233	275	223	238	260	270
	310	305	292	330	291								279	338	247	231	212	213
	194	186	259	282	286			—	—				220	288	253	202	198	207
	190	163	186	196	218	208	194	191	196	197	176	209	190	199	203	166	150	182
40°S																		
	115	95	122	101	158	152	128	164	134	168	148	126	203	159	140	116	122	128
	82	72	124	119	158	142	131	47	—	—	—	—	127	39	104	112	111	105
	46	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
60°S																		

	90°W					60°W						30°W						0°
	calories per square centimetre per day																	
0°																		
	94	98									263	247	238	191	134	208	162	140
	176	28	16									301	306	—	250	—	180	150
	—	—	2								290	295	382	360	312	217	154	173
	—	—	54	47							257	309	318	—	286	257	—	169
20°S																		
	—	—	—	99					126	226	224		249	252	—	228	240	264
	—	—	—	83				206	181	221	231		214	207	215	226	163	198
	—	—	—	49			162	214	246	106	105		51	100	129	187	188	160
	—	—	—	—		133	184	231	230	202	200		178	158	192	224	298	380
40°S																		
	—	—	—	90		58	21	252	76	94	143	166	42	54	19	127	188	353
	—	—	210	—	—	14	71	115	139	89	138	—	—	204	*92*	*54*	—	—
	—	—	—	—	77	39	48	32	*4*	10	10	*56*	—	—	—	—	—	—
	93	111	66	102	100	76	17	14	51	62	54	4	2	4	—		—	—
60°S																		

TABLE IV—MEAN TOTAL ENERGY EXCHANGE

March, April and May

	0°						30°E						60°E						90°E
	calories per square centimetre per day																		
0°																			
	186	153							200	217	220	205	200	197	201	224	252	238	
	258	174	101						232	270	241	221	204	193	212	223	268	276	
	265	—	162						234	203	294	335	248	263	358	389	370	351	
	239	182	99					308	252		296	301	366	406	542	453	422	354	
20°S																			
	190	136	87					390	288	322	334	351	392	454	578	554	586	418	
	199	155	116				355	387	357	366	407	424	400	425	494	533	530	458	
	322	289	204	157		305	392	390	306	290	271	259	249	264	245	224	275	280	
	332	306	330	184	298	344	382	378	350	346	342	352	302	266	246	233	238	259	
40°S																			
	—	285	—	—	—	—	290	148	63	64	127	251	314	235	202	225	240	214	
	—	—	—	—	—	—	—	—	—	—	—	166	146	85	110	146	146	125	
	—	—	—	—	—	—	14	29	—	—	—	—	233	185	42	11	153	249	
	—	—	—	—	—	—	—	—	58	—	—	—	—	—	—	—	—	—	
60°S																			

	180°W						150°W						120°W						90°W
	calories per square centimetre per day																		
0°																			
	—	254	166	—	—	—	—	234	—	—	—	—	203	218	86	127	129	138	
	—	262	—	—	—	—	276	274	—	286	286	282	—	310	253	274	250	254	
	286	314	287	302	206	273	248	261	289	—	—	376	288	250	309	297	297	334	
	257	269	—	334	258	276	298	—	336	278	288	270	254	259	220	288	320	—	
20°S																			
	334	278	285	346	317	260	208	256	349	267	267	298	303	230	209	—	—	—	
	379	314	343	337	—	314	370	—	282	238	324	311	360	313	—	—	—	—	
	265	315	278	292	325	312	222	250	313	324	272	279	306	—	—	—	—	—	
	278	267	307	318	299	266	286	248	242	310	262	—	—	—	—	—	—	—	
40°S																			
	205	195	158	185	206	178	285	347	322	—	—	—	—	—	—	—	—	—	
	183	151	140	149	154	167	403	—	351	—	—	—	—	—	—	—	—	—	
	—	—	—	—	—	—	55	61	138	118	267	146	161	158	211	152	74	162	
	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
60°S																			

June, July and August

	0°						30°E						60°E						90°E
	calories per square centimetre per day																		
0°																			
	139	80							292	285	253	288	259	258	266	306	270	298	
	231	169	34						267	282	210	250	263	248	281	349	315	352	
	266	259	98						287	319	284	346	411	453	412	444	434	475	
	239	168	94					280	296		282	372	454	492	511	545	479	504	
20°S																			
	237	208	94					320	265	342	390	386	415	432	486	549	552	482	
	261	298	119				325	336	316	332	328	301	360	398	435	466	443	361	
	—	259	187	205		413	456	403	298	318	326	302	296	297	334	301	317	306	
	357	230	362	286	417	454	510	492	450	481	498	440	326	298	334	318	287	279	
40°S																			
	—	—	—	—	—	—	161	134	73	95	242	399	350	243	373	309	294	310	
	—	—	—	—	—	—	—	—	—	—	22	85	189	86	208	188	208	236	
	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
60°S																			

BETWEEN SEA AND AIR—*contd.*

March, April and May

calories per square centimetre per day

	90°E						120°E						150°E					180°E
0°																		
	271	237	—	136	169	172	—	142	175	186	161	168	194	240	—	182	—	—
	253	287	277	258	254	269	190	176	211	186	—	158	182	—	201	209	—	—
	329	314	366	358	262	260	220	206	232	246	153	192	237	254	251	—	—	325
	365	359	342	345	319	330	246			—	—	189	328	292	270	275	314	299
20°S																		
	328	346	351	326	364								310	391	360	269	373	378
	341	333	310	328	349								350	405	357	318	353	333
	241	358	251	254	341			—	—				370	404	367	314	262	259
	255	257	218	204	340	330	195	182	217	189	238	250	368	423	308	263	198	219
40°S																		
	144	172	143	121	126	131	172	162	136	96	185	189	132	111	288	226	140	161
	78	102	127	140	128	119	184	146	—	—	—	—	—	—	278	296	174	149
	8	50	10	8	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
60°S																		

	90°W						60°W						30°W					0°
0°																		
	79	63									228	242	270	231	166	157	167	149
	223	24	20									290	362	331	235	210	220	267
	—	—	78								266	339	365	—	497	354	282	284
	—	—	—	33							262	325	367	—	—	403	232	244
20°S																		
	—	—	—	105						225	292	339	350	185	—	198	219	456
	—	—	—	102					198	256	234	288	218	194	—	282	302	350
	—	—	—	70				206	235	300	248	365	134	228	332	259	283	351
	—	—	—	—			167	226	149	377	256	261	186	339	335	271	277	298
40°S																		
	—	—	—	123		14	29	58	110	212	106	166	8	118	—	59	257	310
	—	—	184	—	—	80	50	161	174	250	193	233	124	161	—	—	—	—
	—	—	153	—	94	123	113	70	73	98	88	26	—	—	—	—	—	—
	—	—	118	134	224	195	35	44	86	142	74	50	66	—	—	—	—	—
60°S																		

June, July and August

calories per square centimetre per day

	90°E						120°E						150°E					180°E
0°																		
	270	254	—	214	240	217	—	138	169	—	135	142	240	—	—	201	136	—
	306	308	330	381	223	234	210	200	202	206	191	175	220	180	228	286	—	131
	414	430	459	493	248	250	257	186	164	152	179	202	220	235	343	301	287	210
	492	453	463	518	318	360	299			—	—	214	287	368	434	256	214	226
20°S																		
	350	363	414	396	427								280	378	342	301	316	386
	330	353	376	377	435								325	415	332	297	354	365
	275	284	289	346	466			—	—				376	415	385	316	321	350
	258	280	272	283	389	414	276	242	219	229	261	198	377	390	350	338	243	258
40°S																		
	265	250	234	178	191	186	134	146	189	173	194	150	225	202	262	311	142	190
	133	135	118	90	179	205	165	—	—	—	—	—	—	—	179	198	194	182
	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
60°S																		

TABLE IV—MEAN TOTAL ENERGY EXCHANGE

June, July and August

	180°W						150°W						120°W						90°W
	calories per square centimetre per day																		
0°																			
	302	282	373	308	336	332	—	344	—	—	—	—	220	166	236	151	186	154	
	—	290	374	326	246	—	349	356	275	348	301	326	299	360	220	310	287	270	
	299	234	278	324	330	327	343	354	292	361	—	369	408	385	377	421	385	402	
	316	254	276	328	270	302	302	—	424	422	398	302	291	295	343	316	—	—	
20°S																			
	246	275	245	291	261	339	364	349	251	274	309	269	304	308	291	—	—	—	
	342	350	338	338	346	415	347	308	—	286	252	263	429	—	—	—	—	—	
	326	308	281	326	297	262	332	283	253	305	242	253	—	—	—	—	—	—	
	325	286	270	282	231	238	254	238	233	—	—	—	—	—	—	—	—	—	
40°S																			
	304	329	271	250	226	278	336	—	—	—	—	—	—	—	—	—	—	—	
	204	290	296	278	319	319	218	—	—	—	—	—	—	—	—	—	—	—	
	—	—	304	248	250	291	233	182	160	158	189	194	102	146	202	179	188	214	
	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	173	198	
60°S																			

September, October and November

	0°						30°E						60°E						90°E
	calories per square centimetre per day																		
0°																			
	205	168							152	172	198	147	234	231	251	277	280	270	
	198	191	72						158	190	163	198	286	271	254	302	351	313	
	220	182	130						140	182	224	284	325	330	386	384	429	483	
	184	162	92					220	136		240	290	319	357	442	438	429	450	
20°S																			
	215	147	80					248	226	223	210	228	312	306	230	321	471	452	
	240	172	122				261	338	252	242	227	249	278	230	256	287	388	308	
	162	220	196	171		247	338	302	287	277	259	202	212	198	205	245	187	155	
	170	210	305	230	329	300	295	296	322	339	314	300	285	274	239	268	227	161	
40°S																			
	—	—	434	438	—	—	147	82	120	112	190	322	335	265	297	266	206	246	
	—	—	82	—	—	—	—	—	29	37	2	63	163	101	159	163	138	162	
	100	54	—	—	—	—	—	—	—	—	—	28	*5*	122	66	13	48	157	
	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
60°S																			

	180°W						150°W						120°W						90°W
	calories per square centimetre per day																		
0°																			
	—	325	237	254	—	—	250	223	—	—	—	160	160	94	107	109	110	115	
	—	315	308	—	337	—	266	294	276	270	245	261	240	275	256	205	219	176	
	263	250	280	196	262	282	294	302	330	—	—	338	280	322	324	348	338	301	
	278	248	318	290	314	331	282	—	293	354	302	300	266	279	297	359	—	—	
20°S																			
	198	234	318	338	—	323	294	313	278	265	246	251	242	246	238	—	—	—	
	188	222	235	258	256	224	226	234	240	223	206	145	171	—	—	—	—	—	
	206	183	182	212	—	190	198	187	188	207	134	119	—	—	—	—	—	—	
	201	176	128	144	146	158	194	145	103	90	—	—	—	—	—	—	—	—	
40°S																			
	166	181	193	183	138	142	—	83	—	—	—	—	—	—	—	—	—	—	
	—	183	153	178	164	147	122	126	207	212	—	—	—	—	—	—	—	—	
	—	—	—	—	144	—	62	118	94	106	88	162	151	119	75	122	104	142	
	—	—	—	—	—	—	—	—	—	—	74	50	—	—	—	—	—	—	
60°S																			

BETWEEN SEA AND AIR—*contd.*

June, July and August

	90°W						60°W						30°W						0°
							calories per square centimetre per day												
0°																			
	149	151									273	259	290	270	168	178	97	118	
	225	42	61									296	378	—	—	296	241	234	
	—	—	126								308	368	421	487	398	441	323	345	
	—	—	—	45							276	332	359	—	—	326	243	261	
20°S																			
	—	—	—	129						178	284	270	159	—	—	—	292	315	
	—	—	—	114					239	236	328	250	92	81	374	330	351	282	
	—	—	—	48				107	259	313	295	236	306	358	358	338	270	328	
	—	—	—	62			74	92	446	398	90	20	186	65	—	238	274	266	
40°S																			
	—	—	—	—		74	14	367	146	130	328	—	104	203	480	394	183	—	
	—	—	—	—	—	92	66	218	—	—	119	182	—	—	—	—	—	—	
	—	—	—	—	177	131	144	229	—	—	—	—	—	—	—	—	—	—	
	218	189	205	244	250	—	—	—	—	—	—	—	—	—	—	—	—	—	
60°S																			

September, October and November

	90°E						120°E						150°E						180°E
							calories per square centimetre per day												
0°																			
	265	266	—	205	225	194	—	132	114	—	205	174	174	—	—	221	—	—	
	262	279	325	300	221	170	162	150	126	177	111	124	158	—	342	278	—	—	
	468	383	330	418	278	221	153	127	98	135	178	133	160	224	322	290	254	195	
	478	458	369	422	264	214	162			—	—	134	251	318	378	—	304	218	
20°S																			
	338	337	354	354	386								216	370	216	209	266	261	
	330	294	318	322	339								222	317	267	240	182	204	
	175	251	270	312	338			—	—				275	325	250	226	188	182	
	177	205	185	226	250	256	206	186	169	175	169	138	208	245	205	206	154	122	
40°S																			
	259	280	154	201	197	195	142	128	147	157	131	142	—	164	154	185	135	158	
	160	141	73	51	135	127	150	201	—	—	—	—	—	—	—	—	90	193	
	182	132	54	52	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
60°S																			

	90°W						60°W						30°W						0°
							calories per square centimetre per day												
0°																			
	135	168									260	278	280	242	174	166	177	191	
	158	55	2									274	291	—	238	237	254	257	
	—	—	41								202	230	358	368	359	331	189	197	
	—	—	—	55							206	219	269	—	—	224	—	164	
20°S																			
	—	—	—	84						142	266	273	139	—	—	134	213	226	
	—	—	—	106					222	243	322	187	90	166	160	190	175	226	
	—	—	—	33				174	234	250	243	261	232	201	250	242	198	182	
	—	—	—	66			102	177	230	226	283	272	236	148	170	158	262	267	
40°S																			
	—	—	—	182		48	34	134	119	55	259	—	296	242	—	—	249	—	
	—	—	138	—	—	61	22	124	—	—	135	—	—	—	—	—	150	—	
	—	—	—	—	99	95	67	0	—	24	*13*	*13*	—	—	—	—	6	24	
	134	160	—	—	132	—	*2*	—	—	48	—	—	51	—	—	—	144	91	
60°S																			

TABLE V—NET RADIATION

Annual

calories per square centimetre per day

	0°			30°E			60°E				90°E					
0°																
	331	321					393	387	373	370	361	353	353	347	332	324
	288	298	300				373	369	367	357	355	349	353	345	333	324
	251	—	278				372	369	362	356	360	362	349	343	335	328
	248	253	269				373	377		358	355	358	349	339	337	330	326
20°S																
	257	265	286				349	340	334	335	341	330	319	311	309	303	308
	257	266	291				308	318	314	305	295	283	278	284	281	276	270	265
	—	233	261	275		268	268	267	264	260	252	254	246	244	243	243	238	237
	201	207	213	235	249	240	231	228	225	219	219	216	215	214	214	210	209	209
40°S																
	—	—	—	—	—	—	196	194	187	181	175	173	172	172	171	171	171	171
	—	—	—	—	—	—	—	—	—	—	—	150	153	155	155	153	155	153
	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
60°S																

	180°W					150°W						120°W					90°W
						calories per square centimetre per day											
0°																	
	—	389	406	—	—	—	—	413	—	—	—	—	394	376	353	345	328	308
	—	362	—	—	—	—	403	412	—	395	395	394	—	375	351	331	310	—
	327	336	335	—	350	360	379	381	372	—	—	370	365	348	326	311	—	—
	320	320	—	—	—	336	362	—	335	351	355	353	343	332	327	308	—	—
20°S																		
	303	300	296	302	—	297	299	305	309	312	316	316	310	315	307	—	—	—
	285	283	264	267	—	270	265	—	—	—	287	293	258	—	—	—	—	—
	255	250	232	230	—	232	—	—	229	235	242	246	—	—	—	—	—	—
	228	224	218	206	202	198	—	—	201	—	—	—	—	—	—	—	—	—
40°S																		
	196	186	181	180	179	173	—	—	—	—	—	—	—	—	—	—	—	—
	—	160	155	157	156	153	148	—	—	—	—	—	—	—	—	—	—	—
	—	—	—	—	—	—	—	131	131	128	127	124	127	128	127	128	129	130
	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
60°S																		

December, January and February

calories per square centimetre per day

	0°			30°E			60°E				90°E					
0°																
	406	374					427	415	393	377	370	373	367	365	359	354
	350	357	347				411	406	393	388	384	382	387	376	375	369
	298	292	324				403	406	428	426	430	428	410	405	386	384
	293	300	325				427	424		439	436	436	434	434	408	399	395
20°S																
	329	327	355				436	430	408	428	439	435	428	422	435	423	410
	372	381	398				405	432	427	407	403	407	420	433	418	403	394	378
	354	353	400	424		404	396	401	406	396	384	389	382	377	377	381	369	366
	309	324	340	391	411	389	370	366	359	351	351	354	350	348	349	347	339	339
40°S																		
	—	—	—	—	—	—	339	336	336	326	311	307	302	302	298	299	300	296
	—	—	—	—	—	—	—	—	—	—	287	275	287	288	287	288	290	285
	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	195	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
60°S																		

RECEIVED

Annual

	90°E					120°E						150°E						180°E
	calories per square centimetre per day																	
0°																		
	317	317	—	339	353	361	—	346	331	—	323	330	332	—	—	—	—	—
	320	325	329	340	353	360	370	360	340	337	—	327	317	—	340	346	—	—
	323	324	326	336	364	376	385	390	357	342	333	332	328	331	322	—	—	324
	311	313	313	321	387	406	391			—	—	337	336	337	—	—	318	320
20°S																		
	291	286	291	299	368								332	329	307	305	305	301
	267	259	269	277	311								287	297	305	298	284	282
	231	225	227	225	251			—	—				267	263	258	254	255	258
	205	201	203	203	210	218	223	220	223	231	230	232	240	236	227	225	235	237
40°S																		
	171	169	173	174	169	169	181	181	184	184	199	201	—	198	190	191	204	207
	157	156	157	157	158	157	153	—	—	—	—	—	—	—	—	—	174	175
	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
60°S																		

	90°W					60°W						30°W						0°
	calories per square centimetre per day																	
0°																		
	304	280									375	371	369	370	367	362	351	344
	293	285	284									376	370	—	—	—	324	315
	—	—	275								367	370	353	—	321	292	264	269
	—	—	—	264							353	355	348	—	—	291	—	267
20°S																		
	—	—	—	251						320	320	318	306	—	—	—	274	255
	—	—	—	243					298	305	303	301	287	285	—	271	265	258
	—	—	—	258				271	271	260	250	250	254	246	243	239	238	233
	—	—	—	—			252	254	241	231	223	216	217	217	—	215	212	206
40°S																		
	—	—	—	—		212	213	198	197	196	—	—	—	—	—	—	—	—
	—	—	—	—	—	200	176	174	—	—	—	—	—	—	—	—	—	—
	—	—	—	—	138	138	143	137	—	—	—	—	—	—	—	—	—	—
	—	—	—	—	101	—	—	—	—	—	—	—	—	—	—	—	—	—
60°S																		

December, January and February

	90°E					120°E						150°E						180°E
	calories per square centimetre per day																	
0°																		
	344	346	—	326	322	333	—	350	318	316	329	331	348	—	—	—	—	—
	361	373	355	356	353	344	369	362	341	345	342	355	351	357	361	359	—	—
	375	374	382	379	401	401	394	406	375	363	364	363	388	404	381	387	—	393
	377	372	369	372	435	460	419			—	—	371	412	424	—	402	402	408
20°S																		
	380	371	354	367	464								408	432	401	401	403	398
	379	363	355	368	433								413	395	428	410	400	398
	348	339	344	342	392			—	—				397	394	392	392	389	397
	324	316	325	323	336	355	354	342	352	381	380	378	391	380	369	367	387	387
40°S																		
	295	296	301	302	293	293	306	307	315	314	354	356	338	340	324	321	373	376
	284	282	285	285	286	287	286	288	—	—	—	—	305	306	311	309	335	338
	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
60°S																		

TABLE V—NET RADIATION

December, January and February

	180°W						150°W						120°W						90°W
	calories per square centimetre per day																		
0°																			
	—	388	398	410	427	435	—	434	—	—	—	—	414	386	396	375	357	349	
	—	369	353	—	418	—	431	431	438	433	441	441	435	448	408	389	379	—	
	363	361	343	—	374	397	433	422	424	—	422	438	435	416	392	373	—	—	
	383	366	378	—	—	381	439	—	398	415	431	427	424	417	407	381	353	—	
20°S																			
	387	380	378	377	375	391	378	390	393	409	419	427	412	420	409	—	—	—	
	402	402	381	351	355	373	370	370	389	—	412	412	405	405	—	—	—	—	
	393	389	347	336	353	351	—	—	343	352	382	389	375	—	—	—	—	—	
	350	367	348	337	337	319	—	—	307	321	—	—	—	—	—	—	—	—	
40°S																			
	351	330	313	315	313	294	293	303	—	—	—	—	—	—	—	—	—	—	
	308	301	290	290	290	289	289	—	—	—	—	—	—	—	—	—	—	—	
	—	—	269	272	272	—	—	273	275	264	263	261	272	275	275	273	272	275	
	—	—	—	—	—	—	—	—	234	222	235	236	236	235	246	236	236	247	
60°S																			

March, April and May

	0°						30°E						60°E						90°E
	calories per square centimetre per day																		
0°																			
	337	315							378	387	385	394	382	378	364	353	338	336	
	285	286	283						343	345	359	355	352	360	352	342	320	322	
	264	—	261						333	322	317	320	346	351	329	330	309	300	
	247	247	243					332	336		309	313	328	321	304	311	295	290	
20°S																			
	236	248	245					298	272	272	283	290	283	279	262	262	255	263	
	213	221	233				261	256	252	245	229	209	210	216	215	216	208	198	
	171	185	188	198		204	209	205	198	195	191	187	183	184	178	179	172	174	
	131	131	140	158	167	167	161	160	158	156	153	149	145	144	147	137	138	135	
40°S																			
	—	94	—	—	—	—	117	117	108	104	102	101	99	99	98	97	95	96	
	—	—	—	—	—	—	—	—	—	—	—	72	81	82	80	79	76	77	
	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
60°S																			

	180°W						150°W						120°W						90°W
	calories per square centimetre per day																		
0°																			
	—	364	394	—	—	—	—	415	—	—	—	—	382	362	336	338	362	359	
	—	342	—	—	—	—	382	382	—	360	357	357	—	329	320	329	317	308	
	302	301	290	290	313	331	352	363	353	—	—	341	341	326	309	310	282	273	
	293	293	—	306	287	301	322	—	311	327	324	320	299	304	314	302	274	—	
20°S																			
	265	272	270	267	269	242	260	269	266	273	285	277	274	285	286	—	—	—	
	226	234	226	228	—	220	208	—	211	231	225	238	225	225	—	—	—	—	
	177	175	175	175	170	170	175	173	168	170	168	174	172	—	—	—	—	—	
	144	139	151	146	130	131	134	134	134	136	140	—	—	—	—	—	—	—	
40°S																			
	113	110	118	112	109	106	104	105	101	—	—	—	—	—	—	—	—	—	
	82	79	79	82	78	76	66	—	70	—	—	—	—	—	—	—	—	—	
	—	—	—	—	—	—	51	51	47	48	45	47	45	47	43	48	49	44	
	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
60°S																			

RECEIVED—*contd.*

December, January and February

	90°W						60°W						30°W						0°
							calories per square centimetre per day												
0°																			
	348	321									385	387	379	379	380	378	377	383	
	363	356	354									424	424	—	388	—	376	374	
	—	—	363								440	449	418	409	376	354	369	347	
	—	—	362	381							425	431	416	—	387	361	—	343	
20°S																			
	—	—	—	368						410	414	412	396	380	—	375	348	324	
	—	—	—	372					429	431	431	426	399	396	372	388	388	378	
	—	—	—	397				435	414	397	372	372	370	369	382	365	361	359	
	—	—	—	—			422	418	388	374	352	340	337	331	348	348	344	328	
40°S																			
	—	—	—	348		374	378	347	342	344	—	—	—	—	—	—	—	—	
	—	—	297	—	—	347	333	334	288	287	—	—	—	—	—	—	—	—	
	—	—	—	—	281	283	297	283	273	261	261	249	—	—	—	—	—	—	
	258	268	259	258	237	227	236	217	225	216	214	217	216	210	—	—	—	—	
60°S																			

March, April and May

	90°E						120°E						150°E						180°E
							calories per square centimetre per day												
0°																			
	335	331	—	347	334	331	—	320	313	305	312	320	325	339	—	392	—	—	
	319	317	316	314	320	329	320	322	300	290	—	293	279	—	341	335	—	—	
	297	301	295	295	320	331	342	346	290	283	287	295	294	296	295	—	—	283	
	283	287	285	288	343	364	347			—	—	315	296	304	296	283	272	284	
20°S																			
	251	247	247	247	319								276	268	275	269	262	258	
	209	206	214	220	251								244	242	234	230	220	220	
	171	166	166	166	180			—	—				195	189	188	181	183	185	
	135	136	138	138	141	142	147	143	146	146	147	153	156	152	149	148	152	149	
40°S																			
	96	96	99	100	98	97	100	100	106	105	115	116	122	119	111	118	116	121	
	79	81	78	79	88	82	72	74	—	—	—	—	—	—	75	77	82	83	
	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
60°S																			

	90°W						60°W						30°W						0°
							calories per square centimetre per day												
0°																			
	359	318									333	328	343	350	369	367	363	364	
	311	311	321									329	345	349	352	357	351	345	
	—	—	289								332	328	322	—	313	313	290	277	
	—	—	—	265							321	312	308	—	—	287	274	261	
20°S																			
	—	—	—	224						280	271	269	262	270	—	248	249	247	
	—	—	—	192					245	247	254	252	240	247	—	221	207	198	
	—	—	—	187				198	210	197	195	195	196	180	175	179	174	169	
	—	—	—	—			177	170	176	162	157	149	153	144	143	144	145	134	
40°S																			
	—	—	—	110		127	122	119	120	117	105	113	117	106	—	110	104	94	
	—	—	76	—	—	114	83	84	81	79	84	73	73	70	70	73	73	—	
	—	—	48	—	49	45	48	48	47	45	44	46	—	—	—	—	—	—	
	—	—	23	23	21	22	25	25	24	22	22	24	23	—	—	—	—	—	
60°S																			

TABLE V—NET RADIATION

June, July and August

calories per square centimetre per day

	0°						30°E						60°E						90°E
0°	291	299							336	333	329	315	301	290	318	311	302	287	
	249	258	268						314	317	317	295	296	288	300	295	287	278	
	215	227	238						298	306	290	284	277	286	279	267	268	261	
	208	221	225					279	287		269	259	259	257	244	246	240	235	
20°S	189	191	211					240	227	230	216	218	204	201	189	177	185	194	
	155	151	178				202	200	187	185	172	171	145	152	147	147	147	147	
	—	119	123	127		130	147	135	134	127	121	121	114	113	112	112	108	105	
	87	92	88	91	101	97	94	91	88	85	82	82	87	87	85	84	83	83	
40°S	—	—	—	—	—	—	64	61	54	49	48	48	50	50	49	48	49	47	
	—	—	—	—	—	—	—	—	—	—	35	33	33	33	34	31	32	32	
	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
60°S																			

calories per square centimetre per day

	180°W						150°W						120°W						90°W
0°	352	376	394	380	387	387	—	368	—	—	—	—	367	359	334	322	274	256	
	—	333	341	342	354	—	359	363	361	356	352	348	346	320	309	277	248	227	
	283	300	304	295	304	304	326	335	314	317	—	301	286	280	260	247	227	205	
	245	254	258	248	271	275	298	—	257	260	264	262	259	248	243	225	—	—	
20°S	199	200	205	205	202	199	196	199	209	205	209	211	208	211	179	—	—	—	
	159	153	144	162	154	147	152	148	—	157	160	167	154	—	—	—	—	—	
	118	113	117	115	113	112	108	112	112	113	115	115	—	—	—	—	—	—	
	85	86	85	85	87	87	83	83	81	—	—	—	—	—	—	—	—	—	
40°S	52	51	55	55	55	53	53	—	—	—	—	—	—	—	—	—	—	—	
	25	22	22	22	22	19	24	—	—	—	—	—	—	—	—	—	—	—	
	—	—	*6*	*6*	*5*	*7*	*6*	*1*	*3*	*3*	*4*	*4*	*1*	*3*	*5*	*4*	*5*	*6*	
	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	*25*	*32*	
60°S																			

September, October and November

calories per square centimetre per day

	0°						30°E						60°E						90°E
0°	290	295							432	411	396	395	391	371	362	358	330	318	
	268	292	303						424	406	399	391	386	367	373	369	350	328	
	227	258	289						453	441	412	395	387	384	379	379	376	367	
	244	246	283					454	461		414	411	410	385	375	382	388	383	
20°S	277	296	333					421	431	426	415	415	397	369	370	363	349	364	
	289	310	356				365	383	389	383	378	346	331	334	343	337	331	337	
	289	295	334	351		333	321	326	328	322	315	310	305	301	303	301	303	303	
	277	283	283	302	319	308	298	295	294	283	282	279	278	278	276	272	276	279	
40°S	—	—	247	251	—	—	265	268	248	245	240	236	236	237	238	238	239	243	
	—	—	201	—	—	—	—	—	223	217	221	221	212	215	220	215	222	220	
	195	160	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
60°S																			

RECEIVED—*contd.*

June, July and August

	90°E						120°E						150°E					180°E
	calories per square centimetre per day																	
0°	279	280	—	347	355	368	—	327	308	—	304	305	301	—	—	343	362	—
	269	281	307	321	310	315	342	322	311	303	297	288	275	290	298	305	—	332
	258	263	259	279	308	325	335	338	328	296	278	272	258	265	260	264	272	272
	224	232	240	257	287	291	295			—	—	247	241	236	229	238	243	239
20°S	179	181	222	219	229								218	205	205	199	199	193
	150	148	189	183	170								180	165	170	163	163	159
	108	107	109	112	116			—	—				125	125	120	121	119	119
	84	83	83	84	85	88	90	91	91	91	86	87	91	92	89	88	92	91
40°S	49	47	48	51	44	45	59	59	56	57	59	59	59	58	55	54	57	56
	38	33	36	35	32	32	27	—	—	—	—	—	—	—	28	25	25	26
	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
60°S																		

	90°W						60°W						30°W					0°
	calories per square centimetre per day																	
0°	245	241									355	351	354	371	361	368	346	326
	225	208	195									322	318	—	—	303	281	271
	—	—	172								285	283	283	288	266	259	273	247
	—	—	—	160							276	274	270	—	—	253	220	218
20°S	—	—	—	136						229	234	231	205	—	—	—	188	173
	—	—	—	111					175	186	181	187	164	166	162	159	152	157
	—	—	—	120				117	124	117	124	123	118	123	118	116	116	114
	—	—	—	87			88	96	78	85	90	90	91	98	—	90	87	87
40°S	—	—	—	—		56	58	50	58	57	49	—	55	54	45	51	62	—
	—	—	—	—	—	54	24	21	—	—	28	—	—	—	—	—	—	—
	—	—	—	—	*9*	*9*	*4*	*3*	—	—	—	—	—	—	—	—	—	—
	32	*35*	*32*	*32*	*34*	—	—	—	—	—	—	—	—	—	—	—	—	—
60°S																		

September, October and November

	90°E						120°E						150°E					180°E
	calories per square centimetre per day																	
0°	308	311	—	337	402	414	—	387	385	—	349	355	355	—	—	384	—	—
	332	329	339	370	429	453	441	429	409	409	403	374	362	—	360	384	—	—
	361	359	367	391	427	447	468	472	436	427	402	399	371	367	352	356	350	347
	362	360	359	367	481	509	504			—	—	415	394	384	365	—	356	349
20°S	353	345	340	365	460								428	410	345	353	357	357
	328	320	319	336	390								413	388	389	389	354	352
	297	290	288	280	318			—	—				349	342	333	320	331	331
	276	270	266	266	279	288	300	305	305	307	307	319	322	321	300	298	311	320
40°S	242	238	244	244	240	243	259	259	259	259	268	275	—	275	270	269	270	277
	226	227	228	230	227	228	229	228	—	—	—	—	—	—	—	—	253	251
	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
60°S																		

TABLE V—NET RADIATION

September, October and November

	180°W						150°W						120°W						90°W
	calories per square centimetre per day																		
0°																			
	—	428	437	433	—	—	420	435	—	—	—	423	415	389	357	347	321	270	
	—	405	430	—	425	—	439	471	435	431	432	429	409	395	369	329	296	270	
	359	373	402	413	408	408	404	405	397	—	—	402	399	371	342	315	302	276	
	360	369	363	394	390	386	391	—	376	401	403	403	390	360	342	325	—	—	
20°S																			
	362	349	333	358	—	355	361	363	366	363	352	350	347	346	353	—	—	—	
	353	343	307	328	349	340	329	319	319	311	349	354	349	—	—	—	—	—	
	332	321	288	295	—	297	296	296	296	306	305	305	—	—	—	—	—	—	
	310	304	287	257	255	255	255	264	283	282	—	—	—	—	—	—	—	—	
40°S																			
	268	254	240	237	238	238	—	248	—	—	—	—	—	—	—	—	—	—	
	—	236	229	236	235	228	215	229	225	225	—	—	—	—	—	—	—	—	
	—	—	—	—	192	—	194	203	205	203	205	193	192	194	196	194	203	208	
	—	—	—	—	—	—	—	—	—	—	174	174	—	—	—	—	—	—	
60°S																			

TABLE VI—MEAN ANNUAL

	0°						30°E						60°E						90°E
	calories per square centimetre per day																		
0°																			
	151	185							181	171	159	164	132	124	117	85	70	59	
	70	123	234						155	131	165	147	109	116	115	65	36	37	
	7	—	144						158	147	106	49	56	32	*13*	*47*	*61*	*94*	
	30	80	177					135	158		104	49	3	*57*	*131*	*120*	*100*	*106*	
20°S																			
	54	88	197					47	70	45	40	35	*32*	*83*	*87*	*127*	*188*	*118*	
	46	59	161				1	0	7	*9*	*23*	*42*	*53*	*62*	*89*	*126*	*147*	*101*	
	—	*11*	58	101		*33*	*124*	*97*	*23*	*19*	*9*	19	14	11	*3*	*1*	*14*	*4*	
	126	*75*	*120*	6	*81*	*111*	*159*	*168*	*129*	*140*	*126*	*102*	*61*	*39*	*36*	*43*	*37*	*17*	
40°S																			
	—	—	—	—	—	—	*30*	64	121	99	17	*114*	*140*	*61*	*82*	*55*	*38*	*49*	
	—	—	—	—	—	—	—	—	—	—	—	40	24	89	36	28	23	*1*	
	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
60°S																			

	180°W						150°W						120°W						90°W
	calories per square centimetre per day																		
0°																			
	—	109	156	—	—	—	—	150	—	—	—	—	213	228	223	228	203	184	
	—	76	—	—	—	—	93	102	—	104	120	120	—	104	115	81	73	—	
	61	81	72	—	88	78	91	67	71	—	—	23	48	43	7	*21*	—	—	
	39	69	—	—	—	44	86	—	*16*	1	47	72	91	63	26	*15*	—	—	
20°S																			
	48	38	42	*1*	—	12	23	11	34	70	51	53	79	56	53	—	—	—	
	11	12	*23*	*35*	—	*10*	*25*	—	—	—	41	62	36	—	—	—	—	—	
	5	*8*	*13*	*28*	—	*4*	—	—	24	*12*	*34*	*46*	—	—	—	—	—	—	
	25	*6*	0	*21*	*2*	*14*	—	—	18	—	—	—	—	—	—	—	—	—	
40°S																			
	18	*34*	*3*	2	6	6	—	—	—	—	—	—	—	—	—	—	—	—	
	—	*44*	*31*	*33*	*42*	*37*	*61*	—	—	—	—	—	—	—	—	—	—	—	
	—	—	—	—	—	—	—	13	7	4	*28*	*32*	*7*	6	*11*	*5*	10	*2*	
	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
60°S																			

RECEIVED—*contd.*

September, October and November

	90°W						60°W						30°W						0°
							calories per square centimetre per day												
0°																			
	266	240									427	419	402	380	357	337	322	305	
	272	267	268									430	394	—	346	315	288	272	
	—	—	266								413	419	339	364	344	283	266	239	
	—	—	—	250							391	407	396	—	—	315	—	257	
20°S																			
	—	—	—	276						362	361	361	362	—	—	322	311	275	
	—	—	—	297					342	355	346	340	343	322	321	314	314	299	
	—	—	—	328				333	336	327	311	309	333	312	296	296	299	290	
	—	—	—	297			327	325	321	303	294	285	287	294	287	277	274	274	
40°S																			
	—	—	—	263		294	294	275	267	268	262	—	268	250	—	—	231	—	
	—	—	238	—	—	283	266	264	—	—	233	—	—	—	—	—	181	—	
	—	—	—	—	233	234	230	223	—	209	199	186	—	—	—	—	173	185	
	187	187	—	—	180	—	190	—	—	184	—	—	149	—	—	—	148	171	
60°S																			

HEAT BALANCE

	90°E						120°E						150°E						180°E
							calories per square centimetre per day												
0°																			
	48	71	—	160	148	164	—	215	191	—	149	165	137	—	—	—	—	—	
	52	47	29	54	117	168	192	175	157	163	—	182	130	—	64	59	—	—	
	63	*30*	*52*	*63*	85	124	178	212	190	158	154	152	114	106	36	—	—	88	
	119	*86*	*68*	*110*	92	117	155			—	—	157	62	33	—	—	52	74	
20°S																			
	44	*56*	*63*	*59*	*4*								72	*25*	21	51	2	*31*	
	60	*62*	*55*	*62*	*43*								*7*	*72*	4	27	9	4	
	9	*9*	*40*	*73*	*107*			—	—				*43*	*95*	*56*	*11*	13	8	
	15	*25*	*12*	*24*	*89*	*84*	5	20	23	33	19	54	*46*	*78*	*25*	*18*	49	42	
40°S																			
	25	*29*	*9*	24	1	9	37	44	23	36	34	51	—	39	*21*	*19*	70	48	
	44	43	47	57	8	9	*5*	—	—	—	—	—	—	—	—	—	32	18	
	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
60°S																			

	90°W						60°W						30°W						0°
							calories per square centimetre per day												
0°																			
	190	160									119	114	100	137	196	185	200	195	
	98	247	259									86	36	—	—	—	100	88	
	—	—	214								100	62	*28*	—	*78*	*45*	27	19	
	—	—	—	219							103	59	20	—	—	*11*	—	57	
20°S																			
	—	—	—	147						152	53	42	82	—	—	—	33	*60*	
	—	—	—	142					82	76	27	62	133	122	—	14	1	*5*	
	—	—	—	208				108	36	*17*	27	8	73	24	*24*	*27*	4	*22*	
	—	—	—	—			133	84	*23*	*77*	13	28	20	39	—	*7*	*66*	*97*	
40°S																			
	—	—	—	—		150	185	*5*	85	73	—	—	—	—	—	—	—	—	
	—	—	—	—	—	138	124	19	—	—	—	—	—	—	—	—	—	—	
	—	—	—	—	29	41	50	55	—	—	—	—	—	—	—	—	—	—	
	—	—	—	—	*75*	—	—	—	—	—	—	—	—	—	—	—	—	—	
60°S																			

TABLE VII—MEAN VALUES OF THE TOTAL ENERGY GAINED BY HEAT AT THE SEA SURFACE AND THE CONDENSATION

Annual

	180°W			150°W			120°W			90°W			60°W			30°W			0°
	calories per square centimetre per day																		
0°	132	—	—	77	—	—	55	45	36	17						151	68	32	47
	207	208	168	153	136	136	113	92	—	57	*1*					103	57	29	9
20°S	165	179	171	162	150	135	127	—	—	—	17			163	117	74	—	56	
	—	122	131	—	119	—	131	—	—	102	—		101	139	120	119	125	130	
40°S	119	134	127	—	—	119	145	—	184	—	—	32	105	—	157	—	—	—	
	—	—	—	—	—	—	—	—	—	—	—	141	—	—	—	—	—	—	
60°S																			

December, January and February

	180°W			150°W			120°W			90°W			60°W			30°W			0°
	calories per square centimetre per day																		
0°	170	117	119	83	—	—	71	39	32	14						141	67	34	48
	278	229	236	239	205	126	94	81	—	13	*9*					87	60	18	6
20°S	160	181	168	167	162	92	99	—	96	23	9			167	113	75	47	31	
	56	61	89	—	88	—	117	68	59	33	—		98	102	92	85	70	58	
40°S	107	99	93	68	—	77	86	—	169	—	176	*9*	65	90	111	128	63	—	
	—	136	—	—	97	100	84	100	103	—	—	108	119	139	—	—	—	—	
60°S																			

March, April and May

	180°W			150°W			120°W			90°W			60°W			30°W			0°
	calories per square centimetre per day																		
0°	146	—	—	117	—	—	91	56	27	8						245	114	35	52
	212	180	134	123	100	142	90	58	—	66	2					112	40	19	3
20°S	197	198	161	172	134	176	174	—	87	29	16			153	129	94	90	76	
	—	128	138	123	139	136	129	163	154	155	—		131	131	118	131	139	136	
40°S	126	154	144	—	—	124	147	125	206	—	295	53	109	151	163	157	—	—	
	—	—	—	—	—	—	—	—	—	—	244	176	129	179	—	—	—	—	
60°S																			

June, July and August

	180°W			150°W			120°W			90°W			60°W			30°W			0°
	calories per square centimetre per day																		
0°	136	111	48	65	—	—	41	55	36	23						163	67	32	22
	173	213	130	167	139	136	118	106	—	91	7					123	86	49	25
20°S	186	181	178	151	125	150	141	—	79	80	32			135	100	37	—	90	
	160	194	187	147	149	—	187	—	124	133	160		93	178	134	130	180	194	
40°S	156	170	156	178	—	137	164	210	214	—	—	76	178	—	192	—	—	—	
	—	—	—	—	—	—	—	—	154	—	—	192	—	—	—	—	—	—	
60°S																			

THE ATMOSPHERE THROUGH THE EXCHANGE OF SENSIBLE AND PRECIPITATION OF WATER VAPOUR

Annual

	0°			30°E		60°E			90°E			120°E			150°E		180°E
						calories per square centimetre per day											
0°	69				161	231	256	282	324	269	297	201	215	200	238	241	219	—
	11	25			163	207	181	183	191	206	190	123	124	144	150	158	155	181
20°S	19	*1*		111	118	128	122	125	124	97	70	75				135	131	149
	123	97	127	146	143	139	125	125	119	101	132	157	137	108	119	140	129	109
40°S	—	—	—	—	—	143	149	152	153	149	144	153	149	—	—	—	143	109
	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
60°S																		

December, January and February

	0°			30°E		60°E			90°E			120°E			150°E		180°E
						calories per square centimetre per day											
0°	76				137	281	239	279	336	243	435	398	304	291	303	266	278	—
	5	35			236	175	246	213	200	211	157	150	231	179	188	224	239	133
20°S	5	*13*		144	142	118	115	71	86	68	35	45				144	128	141
	72	52	81	126	100	83	106	99	77	43	72	62	71	58	94	90	82	70
40°S	169	6	—	129	84	110	101	98	103	102	99	132	121	144	144	125	124	112
	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
60°S																		

March, April and May

	0°			30°E		60°E			90°E			120°E			150°E		180°E
						calories per square centimetre per day											
0°	117				182	225	226	306	250	229	195	153	120	248	203	178	211	—
	4	21			226	238	215	209	165	206	178	87	130	275	194	147	134	203
20°S	18	2		124	168	175	161	168	142	107	74	54				144	160	178
	140	70	117	142	165	160	135	111	127	88	109	129	132	117	118	144	137	117
40°S	—	—	—	164	—	156	157	148	151	141	136	147	175	170	115	92	187	134
	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
60°S																		

June, July and August

	0°			30°E		60°E			90°E			120°E			150°E		180°E
						calories per square centimetre per day											
0°	34				163	218	297	276	301	295	254	171	334	195	349	246	167	149
	26	19			90	180	177	198	188	246	271	176	70	108	186	154	132	194
20°S	41	7		111	116	165	145	164	181	144	113	158				164	162	165
	170	172	188	187	169	180	147	173	179	166	211	277	228	179	205	214	173	152
40°S	—	—	—	—	—	168	173	177	191	176	218	199	170	160	—	155	145	125
	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
60°S																		

TABLE VII—MEAN VALUES OF THE TOTAL ENERGY GAINED BY HEAT AT THE SEA SURFACE AND THE CONDENSATION

September, October and November

	180°W			150°W			120°W			90°W			60°W			30°W			0°
							calories per square centimetre per day												
0°																			
	77	62	—	46	—	33	17	29	44	24						55	25	28	64
	164	211	174	85	99	139	152	123	—	59	*2*					90	40	29	3
20°S																			
	115	156	176	157	170	124	96	—	—	—	13			195	126	89	41	27	
	90	106	109	133	101	—	91	—	—	87	67		82	145	135	132	110	131	
40°S																			
	86	115	117	113	—	140	185	—	148	—	217	9	67	—	160	—	—	204	
	—	—	—	—	—	126	—	—	—	—	116	86	92	103	—	—	—	—	
60°S																			

TABLE VIII—MEAN VALUES OF THE SURPLUS ENERGY

Annual

	180°W			150°W			120°W			90°W			60°W			30°W			0°
							calories per square centimetre per day												
0°																			
	152	—	—	213	—	—	159	138	138	97						117	214	169	141
	52	78	115	142	185	199	172	227	—	228	52					178	312	316	216
20°S																			
	101	105	109	117	101	116	155	—	—	—	85			42	148	104	—	217	
	—	121	86	—	94	—	231	—	—	90	—		49	132	95	75	125	138	
40°S																			
	83	51	55	—	—	*20*	*20*	—	33	—	—	23	4	—	26	—	—	—	
	—	—	—	—	—	—	—	—	—	—	—	*9*	—	—	—	—	—	—	
60°S																			

December, January and February

	180°W			150°W			120°W			90°W			60°W			30°W			0°
							calories per square centimetre per day												
0°																			
	97	120	153	210	—	—	92	110	86	75						129	178	163	110
	43	37	15	37	123	192	154	220	—	109	25					201	293	250	159
20°S																			
	61	48	45	63	28	129	162	—	98	85	82			4	112	156	176	185	
	151	158	56	—	58	—	273	148	69	113	—		62	128	61	37	113	199	
40°S																			
	67	34	26	33	—	*3*	34	—	88	—	*26*	45	50	9	38	*28*	*63*	—	
	—	83	—	—	5	*22*	*12*	*17*	5	—	—	*35*	*31*	*109*	—	—	—	—	
60°S																			

March, April and May

	180°W			150°W			120°W			90°W			60°W			30°W			0°
							calories per square centimetre per day												
0°																			
	112	—	—	145	—	—	153	129	166	89						*8*	185	157	149
	57	128	119	146	201	169	173	221	—	355	54					186	326	399	258
20°S																			
	132	120	136	106	150	124	127	—	267	208	87			74	159	143	150	281	
	—	171	163	128	158	135	255	56	268	263	—		69	134	165	91	160	166	
40°S																			
	57	4	32	—	—	*22*	*1*	12	107	—	*142*	*6*	*34*	36	12	*54*	—	—	
	—	—	—	—	—	—	—	—	—	—	*109*	*17*	*64*	*80*	—	—	—	—	
60°S																			

THE ATMOSPHERE THROUGH THE EXCHANGE OF SENSIBLE AND PRECIPITATION OF WATER VAPOUR—*contd.*

September, October and November

calories per square centimetre per day

	0°			30°E			60°E			90°E			120°E			150°E		180°E
0°	49				162	202	262	267	407	311	304	81	103	67	97	276	220	—
	11	27			101	236	88	113	209	161	153	78	64	15	32	106	116	195
20°S	11	*1*		63	45	55	68	96	84	71	59	42				89	74	113
	109	96	121	129	138	132	114	115	95	106	135	160	115	80	57	103	124	95
40°S	—	223	—	—	114	139	167	186	167	179	124	135	128	—	114	—	115	63
	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
60°S																		

AVAILABLE IN THE LATENT FORM OF WATER VAPOUR

Annual

calories per square centimetre per day

	0°			30°E			60°E			90°E			120°E			150°E		180°E
0°	109				50	*23*	*23*	*27*	*43*	*26*	*39*	15	*48*	*28*	*69*	*48*	41	—
	198	88			55	74	167	236	204	187	205	150	82	31	29	97	137	74
20°S	181	111		208	174	183	239	277	302	234	274	288				183	147	146
	149	137	201	235	177	151	123	124	122	141	120	163	81	90	86	179	143	110
40°S	—	—	—	—	—	13	35	27	28	6	*13*	5	*3*	—	—	—	57	40
	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
60°S																		

December, January and February

calories per square centimetre per day

	0°			30°E			60°E			90°E			120°E			150°E		180°E
0°	97				67	*96*	*15*	*44*	*85*	*83*	*214*	*183*	*145*	*122*	*127*	*77*	48	—
	186	81			*46*	62	43	139	84	123	202	131	*26*	10	6	0	0	97
20°S	178	142		145	156	168	229	239	252	247	284	256				137	107	98
	231	182	193	239	164	110	70	96	146	140	159	175	121	138	98	134	124	114
40°S	66	—	—	63	*52*	*44*	10	*44*	*19*	*11*	18	21	*16*	7	*7*	7	*6*	5
	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
60°S																		

March, April and May

calories per square centimetre per day

	0°			30°E			60°E			90°E			120°E			150°E		180°E
0°	76				48	*3*	*27*	*91*	9	33	29	63	49	*59*	*41*	27	*14*	—
	225	110			4	69	106	226	208	136	175	206	94	*36*	*16*	131	131	110
20°S	152	99		253	165	204	257	372	356	230	255	302				220	166	181
	172	149	199	243	158	146	135	126	136	190	123	208	56	86	126	247	176	118
40°S	—	—	—	55	—	25	38	23	30	*15*	*3*	*21*	*9*	*54*	72	29	85	22
	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
60°S																		

TABLE VIII—MEAN VALUES OF THE SURPLUS ENERGY

June, July and August

	180°W		150°W			120°W		90°W			60°W			30°W			0°
						calories per square centimetre per day											
0°																	
	155	234	257	285	—	—	217	174	188	119				113	246	182	151
	103	88	177	166	186	220	227	258	—	176	78			198	336	339	268
20°S																	
	117	122	162	191	145	123	206	—	*7*	81	89		83	183	74	—	220
	151	96	70	130	115	—	202	—	*103*	*25*	*105*	*2*	176	26	99	131	91
40°S																	
	126	104	129	99	—	*70*	*121*	*52*	45	—	—	7	*12*	—	18	—	—	—
	—	—	—	—	—	—	—	—	39	—	—	*6*	—	—	—	—	—	—
60°S																	

September, October and November

	180°W		150°W			120°W		90°W			60°W			30°W			0°
						calories per square centimetre per day											
0°																	
	243	204	—	212	—	189	175	140	111	105				216	246	176	156
	96	60	148	208	230	176	134	209	—	270	50			125	292	276	180
20°																	
	96	131	92	110	81	88	124	—	—	—	82		7	136	43	120	183
	101	61	56	48	46	—	193	—	—	11	*28*	69	90	130	72	95	96
40°																	
	91	62	31	*3*	—	15	8	—	*107*	—	*57*	45	12	—	37	—	—	*5*
	—	—	—	—	—	*33*	—	—	—	—	*57*	23	*70*	*67*	—	—	—	—
60°S																	

Note: In these tables the dashes refer to five-degree squares in which

AVAILABLE IN THE LATENT FORM OF WATER VAPOUR—*contd.*

June, July and August

	0°			30°E		60°E			90°E			120°E			150°E		180°E
						calories per square centimetre per day											
0°	121				78	32	*41*	25	8	*10*	54	57	*151*	*3*	*163*	*33*	71	*16*
	207	77			211	141	276	280	285	202	212	98	177	50	116	132	214	48
20°S	210	100		216	198	186	256	320	278	205	278	273				185	156	190
	112	87	240	278	218	211	157	149	118	108	86	146	31	43	24	175	174	141
40°S	—	—	—	—	—	19	44	92	71	20	*63*	*9*	*22*	21	—	58	92	52
	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
60°S																		

September, October and November

	0°			30°E		60°E			90°E			120°E			150°E		180°E
						calories per square centimetre per day											
0°	142				6	*25*	*7*	4	*104*	*43*	*27*	122	45	72	56	*110*	60	—
	176	84			52	23	245	300	239	286	232	166	83	101	116	132	214	48
20°S	182	102		219	188	174	213	177	321	254	278	321				191	159	115
	82	129	171	179	168	137	128	124	88	85	113	121	116	92	96	160	98	66
40°S	—	95	—	—	*39*	53	49	35	30	31	*4*	28	37	—	22	—	56	81
	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
60°S																		

there were insufficient data for the calculation of energy transfer.

(77416) Wt. 3155/BM 4160 K.7 5/60 Hw.